JAN 5 1917

VOL. LXXIX. No. 2038. [All Rights Reserved.] DECEMBER 15, 1916. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. SUBSCRIPTION per annum, Postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 8s. 10d. ($5.80); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
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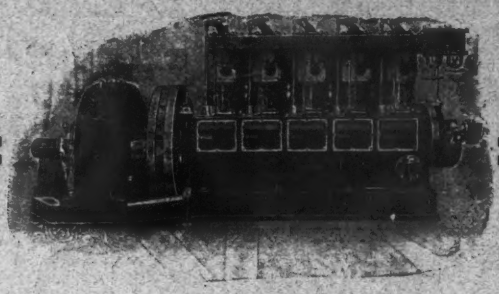

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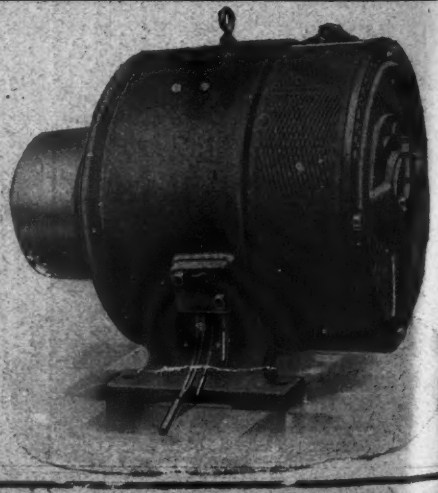

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THE
ELECTRICAL REVIEW.

VOL. LXXIX. DECEMBER 15, 1916. No. 2,038.

ELECTRICAL REVIEW.

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The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

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PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

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TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

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Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1916 EDITION.

H. ALABASTER, GATEHOUSE & CO.,

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DEMOBILISATION AND RECONSTRUCTION.

WHILE there are indications that we are on the eve of great events in respect of further national organisation of our resources for the successful prosecution of the war, there is no disposition to leave such matters as demobilisation and reconstruction after the war to settle themselves. The prime business in hand at the moment is the determined prosecution of the war to complete victory over the powers that were mainly responsible for the world holocaust begun in August, 1914. But we shall commit a graver disaster than perhaps even the war itself unless we prepare, as far as practicable, immediately for some of the things which will inevitably ensue when Peace can be definitely relied upon. Therefore, the publicity which has been given during the past ten days to reports on demobilisation problems and reconstruction proposals cannot be considered ill-timed merely because we are passing through re-arrangements of the Cabinet and the dull days of the third winter of the war.

The report of the Joint Labour Committee on Labour Problems expresses the studied conclusions of a sub-committee representing various Labour organisations. It is estimated, as far as it is possible to foresee matters at the moment, that anywhere between 6,000,000 and 8,000,000 persons, seven-eighths of whom are men, will be discharged or, may we be allowed to say, removed or transferred, from their present employment. Some millions of them are exclusively engaged making what are comprehensively described as munitions of war; many of these will, we suppose, find plenty of other business awaiting them in the same works as soon as material is available. Other millions are probably doing more or less ordinary work now in place of men who will expect to return to their former positions. If ever it were necessary to prepare for an event in advance in order to avoid calamitous consequences, it surely is so in respect of this "colossal general post in industry," as it has been aptly described. It is considered by the Joint Committee that demobilisation will extend over two or three years, and a number of detailed suggestions are advanced as to provision that should temporarily be made available both for the changing munition worker and for the returning soldier, disabled or otherwise. These details will form parts of a policy which will have to be nationally elaborated in order that the burden may be spread as equally as possible, and the State will necessarily have to bear a considerable share in the inevitable cost, for it is as much a war expense as is the cost of mobilisation.

There will be need for the greatest possible consideration, tact, and diplomacy if we are to avoid widespread grievances, for already the soldier does not hesitate to show how keenly he feels the unequal sharing of burdens which deprives him of his all in order that he may fight, while his next-door munitions-working neighbour battens fat on war earnings. Whether and what unemployment compensation shall be granted, and the precise nature of the machinery to be set up for finding occupations for workless men and women, these and many other like points will require before long to be taken seriously in hand by the new Government, but for the present the one really pressing and important thing is for the most efficient possible organisation to be established. For some time past there has been a Reconstruction Committee of the Cabinet receiving and considering all sorts of proposals concerning "after the war," but we opine that the late Cabinet made little advance, its wheels being heavily clogged with the conduct of the war. We have so many committees at work that it requires a master mind to remember exactly how all their different duties are co-ordinated, but the new Government will find it necessary to settle seriously down to consider these reconstruction problems while the War Council wages war without undue waste of time in controversial questions.

But while the Joint Committee of Labour has studied its own special questions, and while the Cabinet Reconstruction Committee has "received" proposals, the Labour Adviser's Department and the Pensions Schemes have not neglected certain very definite aspects of the anticipated situation. And beyond all these, and by no means the least important, the great Federation of British Industries has been assiduously at work. This magnificent organisation, a more powerful industrial federation, we believe, than has ever before been brought into being here, counts among its members most of the great British engineering and industrial companies and works. Formed with many worthy objects, all of which will receive their share of attention in due course, it has, and we think rightly, first concentrated its combined experience and strength upon certain aspects of internal industry as they must occur after the war. It has, at a meeting held in London, of which reports have been published in the daily Press, adopted a number of proposals. In the belief that these proposals form a reasonable basis for timely and profitable reflection and discussion, we print them in full below:—

1. That the cordial and whole-hearted co-operation of employers and employed will be the most important element in the success of any scheme for dealing with the reinstatement of the men of the Forces and munition workers in civil employment, and the general redistribution of labour after the war, and for handling any subsequent problem of unemployment or labour dislocation.

2. That no machinery now in existence can adequately deal with the reinstatement in civil employment of the present Forces.

3. That powers should be obtained from Parliament to set up without delay a Central Statutory Board to regulate and supervise (*a*) the reinstatement in civil employment of the present Forces; (*b*) the settlement in normal employment of civilian workers now in Government or controlled establishments; (*c*) any general redistribution of labour arising out of the war. Appropriate transfers of existing powers and duties will have to be made by the various Government Departments to the Central Statutory Board, so that complete authority shall be vested in the new Board.

4. That not less than two-thirds of the members of this Central Statutory Board should be representatives of employers and employed in equal numbers, such members being appointed by the Crown from associations of employers and from the Trade Unions of the United Kingdom respectively, the remaining members of the Board to include representatives of Government Departments, &c.

5. That where a Trade Union, by arrangement with employers' associations, is capable of placing its members in employment, it should be competent for the Central Board, if it deems it to be in the national interest, to delegate to the Trade Union in question the responsibility of dealing with the reinstatement of its own members.

6. That Local Boards should be established wherever necessary to assist the Central Board. Such Local Boards to have the same proportionate representation as is provided for the Central Board.

7. All expenses properly incurred by the Central and Local Boards should be paid out of moneys provided by Parliament.

The Secretary of the Federation, Mr. R. T. Nugent, has written to the Press stating that these are the proposals of the most important and representative industrial organisation in the country, which comprises among its members numerous large firms and over 40 associations in the iron, steel, engineering, shipbuilding, textile, dyeing, brewing, electrical, chemical, and other industries. These proposals, he states, constitute the first attempt of a representative body of employers and Trade Union leaders to make suggestions for the solution of one of the great post-war problems on definite and practical lines. The organisation sees, as do most others who have studied the position of Labour as it has developed in war-time, that unless there can be far greater agreement between Capital and Labour in future than there has been in the past, we cannot "carry on" prosperously and efficiently as an industrial nation after the war. And we cannot possibly expect to reach any state of after-the-war co-operation of Capital and Labour unless we strain every nerve to secure the redistribution of Labour in the process of demobilisation with the absolute minimum of grievance and friction. We must all agree that "the cordial and whole-hearted co-operation of employers and employed will be the most important element in the success of any scheme" bearing on that matter. The movement to secure industrial harmony, or an "industrial truce" is, to our minds, one of the most important next to the conduct of the war itself; another, of course, to which it is closely related is after-the-war trade organisation and national policy in regard thereto. We trust that the Federation and the Joint Labour Committee will be able to so influence the new Government that the very necessary organisation, fully representative of both employers and employés, which the situation demands, shall get to work without delay. In our new efforts at national reorganisation let us mobilise the right men for this particular national service.

MORALS FROM GERMANY!

We suppose that few men in the City of London will be credited with a shrewder insight into financial and general commercial affairs than Mr. C. J. Stewart, the Public Trustee. Prior to the war it had been his duty to investigate the affairs of many a business which had fallen upon bad days, and some large concerns it was his privilege to personally take in hand and pilot into happier times. We believe that there is nothing but admiration for the excellent way in which he organised and controlled the Public Trustee's Department for the matters which came under its peculiar care in pre-war days. With the European war, and the necessity for us to deal with German-owned holdings in companies operating here, Mr. Stewart's duties naturally took

on an even more complex character when certain responsibility in that connection was relegated to him. Whereas before the war he had occasion to investigate the operations of many a British concern, discovering points of weakness which had occasioned failure, he has during the war had to go most minutely into the doings of successful companies and businesses in which German capital and German influence have been important factors. He could tell us a great many things to interest us did he feel free to speak the manifold details that are in his mind, and we hope that in due course he, as well as those who have had to do with the supervision, control, and winding up of companies, under the Trading with the Enemy Acts, will be free to unburden himself in the interests of the future welfare of British and Allied commerce and industry. He has, we are glad to say, already delivered an address to the City of London Tradesmen's Club on "The Public Trustee and the War," and those who have a mind to criticise everything that is done by public departments which have to handle the war-time difficulties of enemy trade connections, finance and influence, might do worse than read that speech in order to understand how great some of those difficulties and problems are. Compelled to avoid the detail, we fasten upon two pieces of counsel that he has given us as the result of his unique experience. He says that it is no exaggeration to say that 85 per cent. of the enemy companies dealt with by his Department were paying companies. In this respect he felt obliged to give the enemy his due. But why did they pay? Partly because it had been the custom of most of these companies "to write everything down to the bone." Goodwill was always written off, as were big depreciations also. "These companies were in a very strong position, and it was really a lesson to some of our own joint stock companies to see how the German companies acted in this respect."

We do not forget that Mr. Pownall, the President of the Institute of Bankers, was careful in his address, referred to here a few weeks ago, to point out that there were no company promoters in Germany. When we are inclined to sit in reflective mood remembering some of our modest efforts to ensure the soundness and stability of British electrical industry, we recall many an occasion when the Electrical Review referred to the readiness of some British companies to carry the promoter's legacy of goodwill, or to allow patents to stand at what seemed to us extravagant figures, or to fail to provide properly for depreciation—who does not remember glaring cases of failure to write down huge stocks to their proper figure, and the consequences of such short-sightedness? It is to be hoped that engineering and electrical companies who are making war profits will use a fair proportion of such funds as are left, after "Excess Profits" taxes have been taken, to rendering their balance sheets as clean and healthy as possible. Mr. Stewart, at any rate, holds up the German concerns as examples as a result of his personal investigations, and our readers will have learned from our pages what has been the practice of the great Teutonic Electrical Trusts. There are some excellent examples of the same sort of thing where goodwill and patents have practically disappeared from British electrical manufacturing balance sheets, but there are others which may not be free from the influence of the past so soon as one would wish for their good. We can quite believe that a student of the past would blame some of our electrical finance, as strongly as others blame some of our legislation, for the shortcomings of the electrical industry.

Another point referred to by Mr. Stewart, and one upon which we have frequently laid emphasis, is the generosity which these German-owned companies displayed in dealing with their staffs. We do not, of course, say that it is general for British concerns to be ungenerous, but there are businesses which are frequently described to us as "notoriously bad payers." In our opinion, this must inevitably prove in the long run a "penny wise and pound foolish" policy. Englishmen who have worked for German, or partly German, electrical concerns here have told us again and again that they certainly had no sentimental preference for working for foreign companies, but German firms, knowing the value of a good man to them, and observing the British indisposition to pay electrical men a reasonable remuneration, did not fail to take advantage of the situation. They have undoubtedly, in certain well-known exceptional cases, paid very high figures in order to get a British commercial engineer to conduct their operations at home or in the British Colonies. Mr. Stewart says: "They seemed to think it paid well to give the best treatment to their men."

There is a growing conviction that skilled and other factory labour must be better paid if it is to yield the best results in industry. Is there no room for improvement in dealing with the man who does not perform the manual labour of the works, but is the *brains*, or the *business-getter* of the organisation? We are not suggesting that, taken as a whole, Germany pays her own engineers better than Britain does hers, but she certainly has shown a better appreciation of the value of the men to whom she looks to develop her industrial operations, and Mr. Stewart's remarks will not be wasted if they serve to remind British traders and manufacturers of this one detail of German organisation, in which the Teuton has undoubtedly reaped an advantage.

Institution Notes.

The current issue of the *Journal* of the Institution of Electrical Engineers affords further evidence of reform in procedure on the part of the Council, which will be welcomed by all who have the best interests of the Institution at heart. Very little is known by the general body of members regarding the work that is done by the Council, its numerous Committees, and its official representatives on other bodies; hitherto, apparently, it has been the policy of the Council to do good by stealth, and only those who are enabled to obtain a glimpse of its inner workings can form an adequate or just idea of the really enormous amount of work that is performed by the self-sacrificing Members of Council and their nominees—not even the *personnel* of the various Committees, as a rule, being divulged. However, a long step has now been made towards a reasonable measure of publicity, by the publication of a list of representatives of the Institution on 11 external Committees, Boards, &c., that are engaged on "work of national importance," and of a list of members of 11 Institution Committees (with numerous Sub-Committees), together with the names of representatives of other bodies who are not necessarily members of the Institution. The publication of these names cannot fail to strengthen public confidence in the recommendations of the Committees, or to reassure members as to the activity of their leaders, and will, we feel sure, prove beneficial to the Institution.

Nevertheless, we are not yet satisfied. To ask for details of the proceedings of the 21 Committees, Sub-Committees, and Panels would obviously be unreasonable, but need the Council carry on its deliberations always behind an impenetrable veil of secrecy? We hope that we may yet see in the *Journal* at least a précis of the Council's proceedings and conclusions, and that it will take the members more fully into its confidence, and concern itself more intimately with their personal welfare.

In conclusion, our congratulations are due to the Institution on the fourth list of military honours, the ninth list of members on active service, and the fifth list of promotions, &c., all of which show how nobly the members of the electrical profession have responded to their country's call.

RESISTANCE STEPPING OF MOTOR ACCELERATING RHEOSTATS.

By L. BOOTHMAN.

This is rather a hackneyed subject, but the following, culled from practical experience, outlines some points not mentioned in the many articles that have been written on this matter. Incidentally, it tends to simplify the determination of the necessary data for the greater number of motor applications with equally good results to those more elaborately calculated.

An ideal starting rheostat, from a smooth acceleration and current stability point of view, would give a straight line acceleration, *i.e.*, the resistance is decreased uniformly at a uniform rate. This is so, regardless of the type of motor

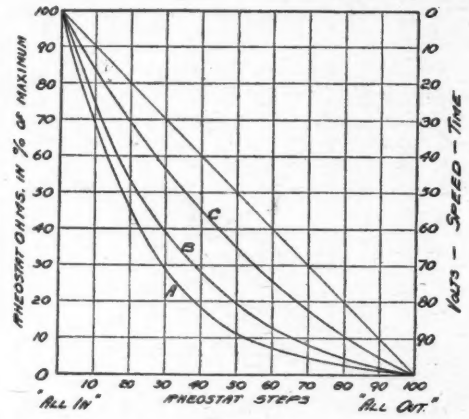


Fig. 1.

or its characteristics, and is practically fulfilled by the liquid rheostat.

The larger number of rheostats used, however, cut out the resistance in a definite number of steps, so that a straight line acceleration is not desirable solely on account of the variable current, torque, and consequent acceleration impulses that would result.

For theoretically limiting the current during starting between a maximum and minimum amount, often the resistance is stepped out in a geometrical ratio, obtained graphically, by calculating or setting of the slide rule. In the case of D.C. or A.C. motors the armature or rotor resistance is required to be known. With series or compound-wound D.C. motors the resistance of the series field, and, in addition, also the saturation curve of the machine, should be known, because in all commercial motors some degree of saturation is present, and the increase in field current strength does not give a proportional increase in counter electromotive force generated in the armature.

Assume a rheostat that is theoretically correctly designed. Now if the operator does not pause sufficiently on any contact to allow the motor to attain its maximum speed for that step, the current rush on the succeeding step will be higher; also if the actual load on the motor is less than the assumed load taken into account when calculating, then after the first current increment the remainder are of less amplitude. The momentary starting torque and current of a motor under load are almost necessarily greater, owing to inertia, than when accelerating. Where the load torque increases with the speed, as with centrifugal pumps and ventilating fans, and during the accelerating period of hydroextractors, the current increases with increasing speed, and, therefore, the increments are damped. With motors possessing a series field, the self-induction of the field winding helps to damp these increments, and the increase in field strength raises the torque more than in the case of a shunt-motor, therefore the motor accelerates at a quicker rate.

With A.C. motors the choking effect of the windings is greater than for D.C. motors, and therefore the current increments are still less. Especially is this the case with small A.C. slip-ring motors having a large number of turns on the windings, and calculations based on open-circuit slip-ring voltage and current, with the rotor stationary and full voltage on the stator, will not allow the assumed current to flow.

A point sometimes overlooked is that in the case of constant-torque machines the time required for acceleration is in proportion of the total time to the amount of resistance cut out at each step; the capacity of the resistance should be designed accordingly. On cutting out a section of resistance the rate of acceleration is increased, and as the motor gains in speed, gradually decreases, but the average rate can be taken as constant.

In the actual manufacture of rheostats, use has to be made of an available range of standardised resistance units which have fixed and definite steps, and which are commercially very good if accurate within a 5 per cent. ohmic variation. Cast alloy resisters vary as much as 20 per cent. in ohmic value from their designed standard, due to variations in material, &c. Carbon resistances vary in their ohmic value from time to time, due to humidity, contact pressure, and other causes depending on their design, in addition to the inherent negative temperature coefficient of carbon, while some metals in use have a positive temperature coefficient, and thus by the time the later steps are reached their resistance has already changed. This alteration is again a variable quantity, depending on the temperature attained. Even when the resistance steps are carefully calculated, especially where a standard line of starters is developed and kept in stock, a theoretical source of error occurs immediately if the machine resistance assumed differs from that of the actual motor that the rheostat controls. All this tends to nullify the nice calculations that have been made, and only in exceptional cases is there any need for them. Users of electrical apparatus are more concerned with their practical immunity from breakdown than with any supposedly theoretical accuracy in design.

In general, the number of starting steps is already fixed, depending on the type of controller, and the stepping can be quickly made by means of the curves here shown, selecting one according to the acceleration and type of rheostat required. The curves are plotted to percentages of total rheostat ohms and steps, and preclude any necessity for knowing armature resistance, &c. It is immaterial whether

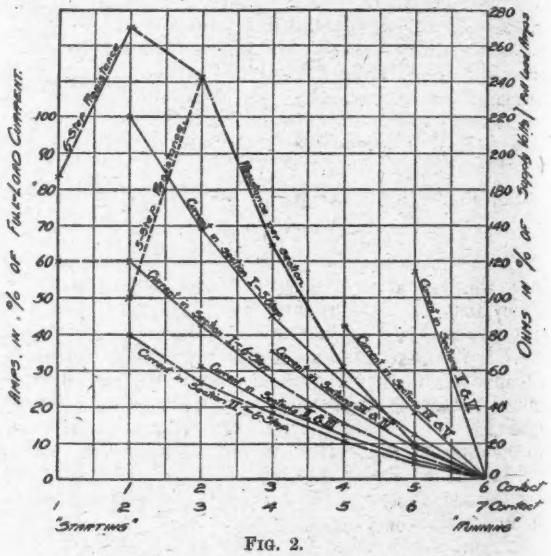

AMPS. IN % OF FULL LOAD CURRENT
OHMS IN % OF
Current in Section 1 & 2
Current in Section 1 & 2 & 3
Current in Section 1 & 2 & 3 & 4
Current in Section 1 & 2 & 3 & 4 & 5
Current in Section 1 & 2 & 3 & 4 & 5 & 6
1 2 3 4 5 6 Contact
"STARTING"
1 2 3 4 5 6 7 Contact
"RUNNING"

Fig. 2.

the motor is started under load, as the total resistance is determined by the torque, *i.e.*, current required at starting. The straight line in fig. 1 is drawn for comparison. The curves represent the rate of motor acceleration. With motors exerting a constant torque they also indicate approximately the speed of the motor in R.P.M. at any point during starting (assuming the motor has been allowed to attain its maximum speed for that step), the time required to reach that speed, and the voltage drop across the motor. This is all expressed in percentage of the normal. For given conditions the total energy dissipated in resistance during starting is practically the same for all curves.

Curve A is a typical geometric ratio stepping. For the

faceplate type of rheostat, I do not recommend this, as the comparatively large voltage drop between the first contacts is liable to create arcing.

Curve B is preferable, and with series motors it gives a more uniform acceleration with less current variation than would Curve A

Many "slow-motion" or "step-by-step" rheostats, either hand or automatically operated, give an equal time interval on each step. If geometric stepping is used for these, and the motor is accelerated to its corresponding speed on the first contact, then the succeeding time intervals are in an increasingly greater ratio than necessary, increasing the amount of resisters required, and lengthening the total time for acceleration, with greater energy loss in the resistance. In practice a compromise is often made between this and equal stepping, as per Curve C. The current increments that ensue, it is found, present no difficulty, and it is often more important with starters possessing only a few steps to have a more uniform acceleration than to have regard to these increments. Compare this with the auto-transformer, star-delta, and series-parallel starting of A.C. motors.

For starting large motors it is difficult to utilise to the best advantage the large capacity, with low ohmic value, required if using resistance that is first of all in series, and then cut out in steps. The best plan is to insert a section of resistance, and then parallel the others with it successively. The curves shown in fig. 2 for D.C. motors are for a five-step starter, allowing normal full-load current at starting, and a six-step, allowing 60 per cent. on the first contact, and attaining full load on the second, using parallel resistances throughout. The resultant resistance in circuit, with the motor at each step, is identical with Curve C in fig. 1. The actual ohms (expressed as a percentage of supply voltage/full load current) for each section of resisters is shown. It will be noticed that the resistance curves for the five and six-step starters coincide from one point, and that the current curve for the first section of resisters in the five-step is exactly the same as the resistance Curve C in fig. 1. The amperes for sections 1 and 2 in the six-step starter, added together on the various steps, also coincide with Curve C. Of course, the actual currents on each step, when added, total 100 per cent. of normal, *i.e.*, current increments are neglected. By these curves it is easy to obtain the capacity of resisters required for any motor and starting conditions where these numbers of steps and this acceleration are suitable, and similar curves (or, preferably, tables), can be made to cover a range of apparatus.

THE ALEXANDERSON MAGNETIC AMPLIFIER.

The two fundamental difficulties met with in radiotelephony, but not in radiotelegraphy, are: the necessity of generating a uniform series of continuous or undamped electrical oscillations at an exceedingly high frequency, and of adequate power; and the fact that the carbon microphone, which is still the most convenient and efficient instrument for the reproduction of atmospheric vibrations in the form of fluctuations in an electric circuit, can deal only with very moderate currents and small power. The problem of generation has been solved in various ways, including the construction of alternators of very high frequency to the design of Mr. E. F. W. Alexanderson, of the General Electric Co., U.S.A.; the same inventor has also devised an extremely ingenious method of enabling the small variations of electric power produced by a microphone to be enormously magnified, so as to control power of any desired magnitude, and to reproduce faithfully the vibrations set up by the human voice, on a vastly greater scale. An account of this invention was given in the *General Electric Review*, and as Dr. J. A. Fleming, in his recent course of lectures on "Long-Distance Telephony," referred to it as of considerable promise, the following description may be interesting. The article from which we derive the particulars was a reproduction of a paper read before the Institute of Radio-Engineers, U.S.A., in February last, by Mr. Alexanderson and Mr. S. P. Nixdorff.

The fundamental principle of varying an inductance by changing the permeability of an iron core was suggested in the early work of Fessenden, as a means of changing the tuning of a radio antenna; the magnetic amplifier shown in its simplest form in fig. 1 was, on the other hand, developed as an accessory to an alternator, in order to take advantage of the better mechanical construction of a solid steel rotor, and yet produce the results that could be obtained by field control in a machine with a completely laminated magnetic circuit. The combination of the constant-field alternator with the stationary controlling device produces the same effect as a machine with variable field excitation,

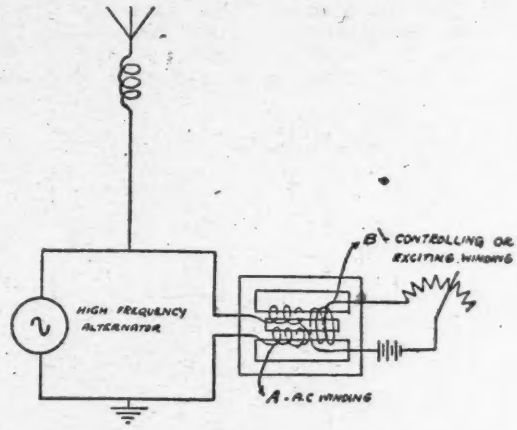


Fig. 1.—Connections of Simplest Form of Amplifier.

as regards not only the proportionality between excitation and electromotive force, but also such phenomena as self-excitation and instability.

If two windings are related to one another and a common magnetic structure, as shown in fig. 1, it is evident that there can be no direct transformation from one winding to the other; for each turn in the controlling or exciting winding B includes both the positive and the negative branch of the flux produced by the A.C. winding A, and hence no resultant electromotive force is induced in winding B. On the other hand, the current in either winding-

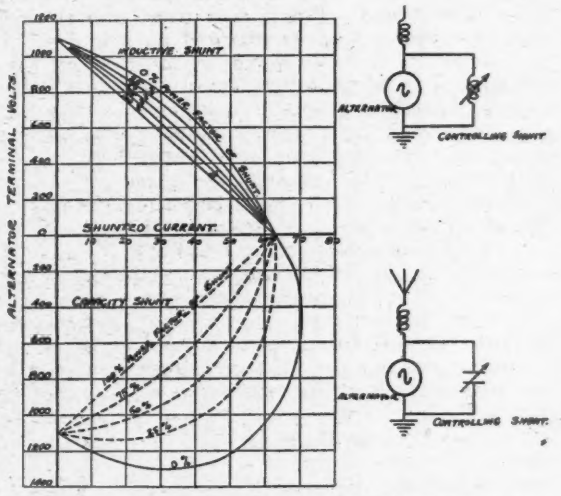


Fig. 2.—Characteristics of Amplifier Controlled by Variable Shunt.

influences the permeability of the common magnetic material, and therefore changes the inductance of the other winding.

If a current flows in either winding of sufficient intensity to saturate the iron, the latter is thereby rendered practically non-magnetic, and the inductance of the other winding is reduced to the value it would have if the coil included only air. If, on the other hand, a current flows in the other winding which gives a magnetomotive force equal and opposite to the first, the iron is rendered magnetic

again. As the two branches of winding A are relatively opposite to winding B, one branch will oppose the ampere-turns of winding B on one half-cycle and the other branch during the next half-cycle. In order to have any large flux variation in winding A, the opposing ampere-turns must be at least equal to the ampere-turns in winding B. The relation of currents is substantially the same as in a transformer between the primary and secondary currents, although in this case one is an alternating and the other a direct current, or a current of different frequency. It is

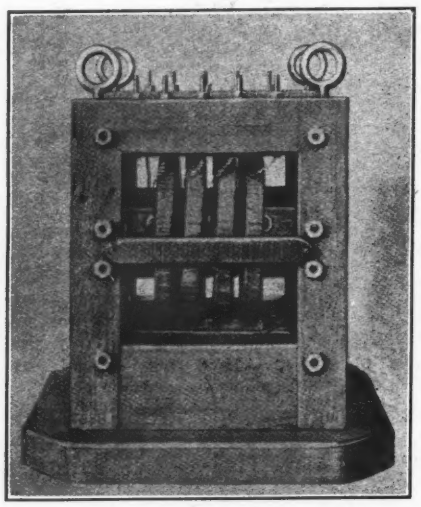


Fig. 3.—Amplifier Used for Tests.

thus obvious how current flow in winding A can be regulated proportionately to a controlling current in winding B. When the magnetic amplifier is used in shunt to the alternator, as in fig. 1, it has the immediate object of controlling the voltage rather than the current; the combined characteristics can be derived from the characteristics of the alternator when operating on an antenna and at the same time controlled by a variable shunt across its terminals, as shown in fig. 2. It is also possible to connect the amplifier in series with the alternator and the antenna, but the shunt connection is preferable, because its effect is the same as if the E.M.F. of the alternator in the antenna circuit were reduced, whereas in the series connection the amplifier does not influence the E.M.F., but changes the tuning of the antenna, and the working conditions are less satisfactory. The two A.C. windings can also be connected either in series or in parallel; this will be referred to later. Fig. 3 shows an amplifier used for tests with an alternator of 72 KW.

While the power expended in the controlling circuit in varying the antenna circuit is very small, there is a large amount of magnetic inertia to be overcome, which is equal to the energy stored by the change of the magnetic field, or the integrated area of the saturation curve between the points where the changes take place, and calls for a wattless flow of energy proportional to the energy per cycle, and the number of times per second the energy must be delivered and returned. The energy of the controlling field is not necessarily equal to the energy of the high-frequency field, but is of the same order of magnitude. The ratio of amplification is proportional to the ratio between the frequencies of the radio current and the controlling current. It is obviously desirable to produce a maximum flux variation in the high-frequency circuit for a minimum variation in the controlling circuit, and to reproduce in the antenna circuit the telephone current in its true shape, and the authors discuss the conditions that must obtain at considerable length.

The parallel connection of the A.C. windings is found preferable to the series connection, having greater sensitiveness, and being able to carry large currents without causing instability. In this case the flux variations in the two branches of the core must be identical, because they produce the same terminal voltage in the two windings, which are connected together; but the currents in the windings are indeterminate, because a cross-current of unknown strength may circulate between the two coils. This induced current tends to oppose any change in the average flux, and thus a telephone current in the controlling winding would simply cause a corresponding short-circuit current between the two A.C. coils without producing the desired flux variations. But as the A.C. winding need operate only at "radio" frequencies, which are very much higher than the frequency of the telephone current, it is possible to find a value of a condenser such that it acts as a short-circuit for the radio-currents, and an open circuit for the telephone current. Hence a condenser is introduced in series with each of the A.C. coils as shown in fig. 4.

Without the condenser shown in series with the amplifier, the upper curve in fig. 4 shows the relation between alternator volts and amplifier excitation; this curve approaches the axis of ordinates asymptotically with increasing excitation of the amplifier, and the voltage can be reduced to zero without using an excessive excitation current, so that the amplifier can be used as a controlling device for radio-telegraphy. In this form it is not suitable for telephony, on account of the departure from proportionality. This is remedied by inserting a series condenser as shown in fig. 4, the sensitiveness of the amplifier being at the same time greatly increased, so that a much smaller control current is needed, but a limit is set to the latter effect by the introduction of appreciable core loss due to hysteresis and eddy currents. The lower curves in fig. 4 show the variations of alternator voltage that can be obtained by using different values of series capacity, and the corresponding increases in the sensitiveness of the amplifier, as represented by the steepness of the curves, which also indicate that the increased sensitiveness is gained at the expense of range of control, or difference between maximum and minimum voltage. All the curves show a practically linear proportionality between excitation and voltage over almost the whole range available. The effect of departure from linear proportionality, and the con-

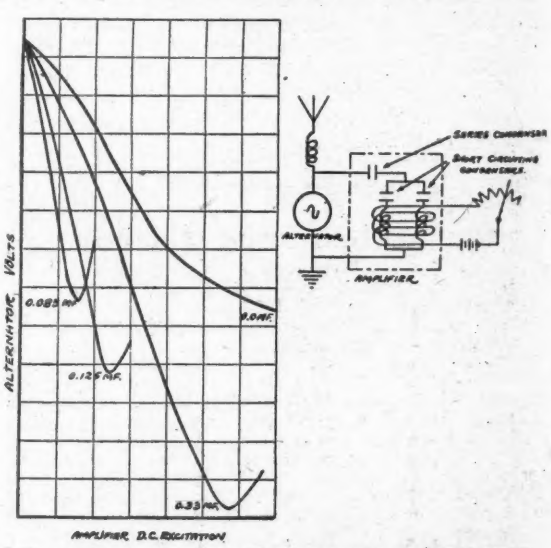


Fig. 4.—Curves Showing Sensitiveness of Alternator Voltage Control with Different Series Condensers.

sequent distortion of wave shape, is shown in the oscillograms of fig. 5.

The amplification ratio is defined as the difference between the maximum and minimum kilowatts output, divided by the effective alternating volt-amperes supplied to the controlling winding, and for operation suitable for telephone control ranges from 100 : 1 to 350 : 1.

A further improvement in sensitiveness can be obtained by using a combination of shunt and series condensers, the shunt condenser being so proportioned as to make the amplifier take leading, instead of lagging, current at low excitation, and allowing the alternator to assume its full maximum voltage. Fig. 6 shows an alternator output of 72 KW. controlled by telephone; the two curves on the

oscillograms, which are relatively upside down, show that the variation of the alternator voltage is in all details an almost exact reproduction of the controlling telephone current.

Apart from telephony, the magnetic amplifier is expected to prove of value as a non-arcing key for telegraphy, and particularly to make possible high-speed telegraphy at the same rate and with the same means as high-speed automatic

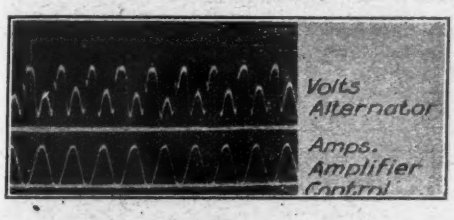


Fig. 5.—Effect of Lack of Proportionality upon the Wave Shape.

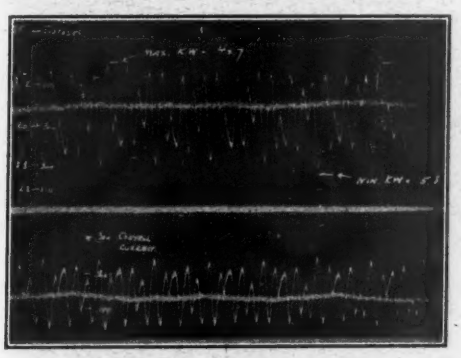


Fig. 6.—Oscillogram Showing Telephone Control.

telegraphy on land lines. Oscillograph records have been taken of telegraphic control from 500 to 1,500 words per minute. There appears to be no limit to the power that might be controlled in this way with apparatus of suitable dimensions.

LINKING-UP—AND FALLING OUT.

By "ROVER."

The article, "Linking-up Electric Power Stations," in the issue of November 17th, reminds me of some operating experiences in America, in cases where two or three stations were connected. There was no question of different phases or frequencies, these being merely cases of power houses of similar systems of supply working conjointly. In all instances there was a three-phase system driven by water power.

In the first case three power houses were interconnected—one of 6,600 KW., one of 3,000 KW., and one of 500 KW. The largest station generated at 4,400 volts, stepped up to 44,000 volts on the transmission line, and was 25 miles away from the distributing sub-station. The second and third generated at 11,000 volts direct on to a transmission line, and were respectively 7 and 10 miles away from the point of distribution. Previously the big station had been supplying an area by itself, but at times of peak load it was over-loaded, whereas the peak load in the other area happened at a different time of the day, so it was decided to link-up the two areas. Both systems had a frequency of 60.

The interconnecting was done by means of static transformers, 44,000—11,000 volts, with a synchroscope and oil switch, all situated in a sub-station in the main distributing area. It should be emphasised that in the big station there was no opportunity for speed regulation, as the governors were set for 60 cycles at full load, and locked in that position. In station No. 2 a certain amount of hand regulation of the governors was possible. There was no automatic voltage regulator on the system.

All regulation for synchronising was, therefore, done at station No. 2, the operator at station No. 3 being merely told to stand by in case of a bad shot. To further complicate matters, the load on the area supplied by stations Nos. 2 and 3 comprised a good deal of mining machinery, including various hoists, a 500-H.P. pump liable to start or stop at any moment, and a 400-H.P. compressor which caused a variation of load of about 250 KW. every 35 sec. Add to this the fact that the governors at station No. 2 acted rather sluggishly, and you will then be able to gauge the state of mind of the operator in the sub-station trying to get a phase, 7 miles from the nearest power house. The telephone wires were strung on the same poles as the transmission lines, and hearing was not always distinct. Sometimes the operation took a quarter, sometimes half an hour, but always the staff were worked up to such a pitch of irritation and profanity that it was only the long distances between stations which prevented bloodshed.

The connection once made, things went fairly smoothly, although a short circuit in the distributing area—no uncommon occurrence in a mining camp when surface blasting is being carried on close to transmission lines—was liable to shut down all three stations; the connecting oil-switch, too, had a maximum relay set for about 1,000 KW., which occasionally opened when the sub-station operator's back was turned, giving stations Nos. 2 and 3 a pretty nasty jar, and temporarily spoiling the harmony between operating staffs.

Another supply system, of which I have more or less pleasant memories, was also in a mining camp. There was also a load of 5,500 KW. divided between two power houses 25 miles apart, one station of 5,000-KW. capacity, supplying 4,000 KW., and a smaller station of 1,800 KW., supplying 1,500 KW., both stations directly coupled to the same transmission line. The daily load factor was in the region of 90 per cent., and the work of operating consisted chiefly of booking the hourly readings and cursing the mosquitoes, which made even that slight task hard work. When the inevitable short occurred—caused by lightning, violent wind storms, or air concussion due to blasting—both stations were brought out. The bigger station went back on the line first, after five minutes' interval to allow all workmen to get clear, and then when the oncoming load had steadied a bit, station No. 2 would connect up, switching in one machine after another.

On this system fairly cordial relations existed between the staffs of the two power houses, except for the usual mutual complaint that the other station was running at an unfairly high power factor. On one occasion, however, relations got very much strained owing to shortness of water. Low water at the larger station forced the management to disconnect some of the load in the camp, and to run only one 2,500-KW. set instead of the usual two. The smaller power house, being situated further down on the same river, had perforce to shut down a set as well, and it was arranged that the larger station should carry full load on its one set, leaving the smaller station, with a much less load, to do the voltage regulation. This the smaller station either could not or would not do, and station No. 1 was accordingly sometimes carrying 25 per cent. overload, and sometimes running at three-quarter load. The superintendent of the larger power house thereupon decided that No. 2 should be forced to do the regulation, and he had his machine taken off the governor and placed on hand control, with the gate opened to the full-load mark. He ran in this condition for about a week.

The poor operators at No. 2 did not get a moment's rest during that week, and had to call in assistance to book their hourly readings. This state of things produced a good deal of friction between the two stations—No. 1 complaining of the inadequacy of the regulation by No. 2, and No. 2 cursing at having to attempt to regulate a very variable load on such a small machine.

Providence, however, straightened things out rather quickly, by sending some heavy rainstorms and increasing the water supply. But in the meantime our largest consumer had done his best to stir up further strife by developing a faulty main switch. This consumer was demanding about

1,000 kw., and occasionally his switch opened without warning. Then there was a lively time in both power houses—one on hand control with the gate wide open, and the other carrying about 400 kw. Station No. 2 lost their load completely, and both machines speeded up to a terrific extent. Station No. 1 had to close down on their water-wheel gate—not a very quick or easy operation when on hand control—and got everything nicely steadied down when the consumer started up again, and they had to open their gate once more. At the end of the week No. 2 declared their governor had broken down under the strain, but by this time the water level had risen sufficiently to run two machines at the larger station, and peace was restored.

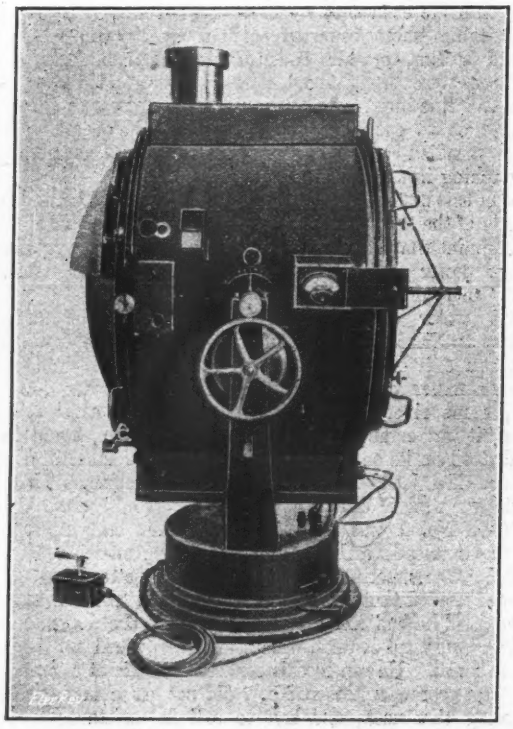
I think, therefore, that while the development of the linking-up of the 38—or is it 138?—London stations will prove highly interesting from a technical point of view, as a psychological problem it should be of absolutely absorbing interest—especially to those operators most closely concerned.

THE SPERRY SEARCHLIGHT.

By the courtesy of the Sperry Gyroscope Co., Ltd., we were recently enabled to witness the operation of the Sperry searchlight, which was described at some length in our issue of September 8th (page 256). At the present time, searchlight work is of more than ordinary interest, and the Sperry lamp particularly so, on account of the enormous advance which it represents on current practice using the pure carbon arc.

This advance is not only shown in the more powerful beam of projected light, but in the ingenious mechanism and adjustments provided.

The lamp, which we believe is the only complete

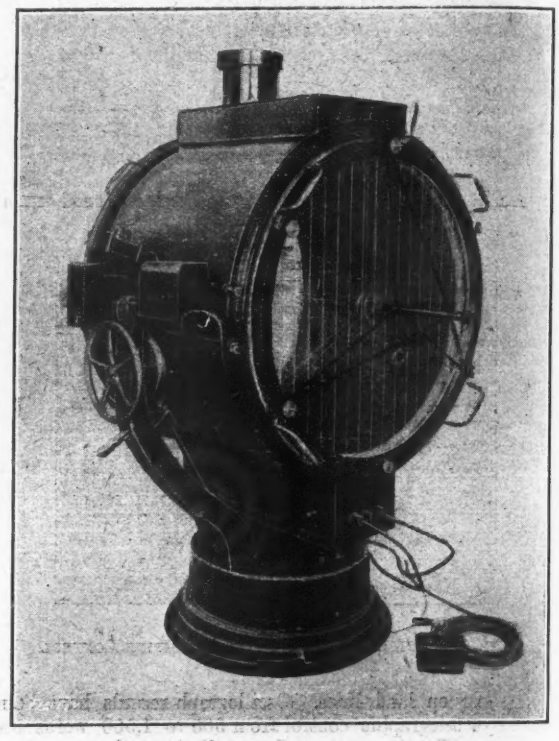


The Sperry Searchlight; Side View.

one which has been shown in this country, was the 90 cm. size, giving a maximum c.p. of from 105,000 to 112,000, with a wide angle of high intensity, this comparing with a maximum c.p. of 44,000 over a small angle in the case of the ordinary pure-carbon arc 90 cm. searchlight.

The greater brilliancy of the Sperry arc has been obtained by making use, in addition to the heated crater surface, of superheated vapour produced in the arc, which burns in a flame above the latter. This result is due to the use of a specially impregnated positive carbon, the core being so proportioned that it burns away faster than the carbon shell, thus producing a deep crater.

Owing to the small size of the carbons, rapid burning of the positive carbon is necessary to secure



The Sperry Searchlight; Front View.

the necessary supply of vapour, and in the 90-cm. lamp, the positive carbon is 110 cm. long and 1 mm. in diameter, burning at the rate of 18 cm. per hour, with a normal current of 150 amps. The negative carbon is 30 cm. long and 11 mm. in diameter, of solid carbon, copper coated.

The intrinsic brilliancy of the bright vapour in the positive crater is about 500 c.p. per sq. mm., and the distribution curve is much more uniform than in the pure-carbon arc.

While the reader is referred to our previous article on September 8th for a detailed description of the lamp mechanism, we may briefly indicate some of its features here.

To prevent the carbons being burned in such a way as to interfere with the formation of a proper crater, and to protect the feeding mechanism from the intense heat of the arc, a current of air is forced up through the electrode supports, which are narrow rectangular tubes designed to offer a minimum obstruction to the light. The air escaping round the positive holder is so directed as to shield the latter from direct radiation and cool it, and also serves to hold the arc flame in position and carry off waste gases.

The electrode supports are carried on a rectangular control box, situated underneath the drum, and containing all the essential mechanism for operating the arc; the cooling air for the electrodes is supplied by a small motor-driven fan in the control box, and the latter box, with the electrodes, &c., can be removed bodily from the drum, if required, in a few seconds.

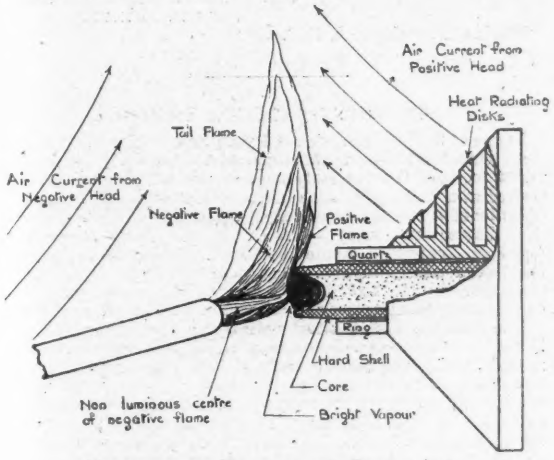
The small fan motor, by means of a suitable gear train and mechanism in the positive head, feeds the

positive carbon forward; the same motor also slowly rotates this carbon in order to maintain the symmetry of the crater and prevent the escape of the bright vapour.

The positive crater is kept at the focal point of the mirror either by hand control or automatically by means of a thermostat and solenoid, its actual position being ascertained by means of an image of the arc thrown on to a ground glass screen, on which a line is drawn to indicate the correct position of the positive tip.

The automatic control is a most interesting feature; a small focusing mirror inside the drum is so placed as to direct a beam of light through a slit on one side of the latter, on to the expansion strip of a small thermostat attached outside the drum, whenever the crater moves from its correct position, by the carbon burning back. This causes the thermostat contacts to open, de-energising the solenoid in the control box, and enabling a clutch mechanism to advance the carbon the correct amount. This control system gives satisfactory results, the regulation being closer than that obtained by manual control.

The negative carbon is also fed through its holder (but is not rotated), the movement being effected by the small fan motor, previously mentioned, under the control of a shunt solenoid connected directly across the arc, and also placed in the control box.



Diagrammatic View of the Sperry Arc.

The voltage across the arc can be varied by adjusting a tension spring which opposes the shunt solenoid.

The negative carbon is inclined at an angle of 14 deg. to the horizontal, the design of the holder being such as to cast the minimum shadow on the mirror; the negative holder and its support can be swivelled round sufficiently to permit the insertion of a new carbon from the front, the turning movement automatically relaxing the grip of the holder in order to facilitate this.

The negative holder and support are mounted on a sliding carriage on the control box, and when the current is off are drawn into striking position by a spring; when the arc is struck they are drawn back into the running position by a series solenoid.

In order to rapidly disperse the gases produced by the arc, which would otherwise form dense clouds in the drum, thus obstructing the light, and leave a possibly corrosive deposit on the mirror, and for other purposes, forced ventilation of the drum is necessary.

It is also necessary, especially with a short focal length mirror, to cool the mirror and its supports in order to prevent it from being cracked by the intense heat of the arc. For this purpose, a small motor-driven extractor fan is mounted in a little casing on the top of the drum; this draws air down over the back of the mirror and up across its face to the exit situated over the arc. It has been found that large currents of air can be drawn through the drum without affecting the arc, which is shielded by its own ventilating system, and that fume extraction and ventilation can be effectively combined by the arrangement adopted.

The projector lamp is suspended in trunnions mounted on a turntable on the base, in the usual way, and arranged for either hand or power training the training motors and the series resistances for stabilising the arc being mounted in the base.

It may be noted that the arc strikes up immediately it is switched on, and on switching off a red glow continues for a short period, during which the intensely hot carbon tips are cooling; an iris shutter is, however, fitted by means of which the light can be instantly controlled or obscured.

The Sperry searchlight is built in three sizes, for 60 cm., 90 cm., and 150 cm. projectors; when required a remote control system can be provided to enable it to be operated from a distance.

Turning to our views, it will be noted that the long positive carbon projects, in a holder, through the glass front of the drum; on the operating side of the drum are mounted a small case containing a combined volt and ammeter, also further back the thermostat in its case, and above it the ground glass observation screen for the arc. Observation holes with dark glasses are also provided on either side of the drum, also a variable resistance to control the speed of the fan motor in the control box. The main switch for operating the arc is situated under the front of the drum, with a projecting handle, and the current passes through the two tubular electrode supports—which are insulated from the control box—to the carbons, silver brushes being provided for this purpose in the case of the rotating positive carbon.

In conclusion, it will be seen that the Sperry searchlight represents a great increase in range and target illumination, two factors of great importance in warfare, where ability to pick up an enemy and, at the same time, to blind him, at the earliest moment is essential.

THE PARALLEL OPERATION OF ELECTRIC POWER STATIONS.

The paper by Mr. J. S. Peck on this subject was discussed by the Birmingham Local Section of the Institution of Electrical Engineers on December 6th. An abstract of the paper appeared in our issue of December 1st.

Mr. R. A. Chattock, in opening the discussion, spoke of the advisability of linking-up generating stations, as this contributed to greater over-all efficiency of the stations and increased the reliability of general supply. He thought the case for linking-up was quite made out by such considerations, and the practical difficulties were not insuperable.

Mr. A. M. Taylor explained by the aid of diagrams that the use of Tirrill regulators was inadvisable in linked-up systems owing to their inability to permit the voltage of one station to adjust itself to variations of conditions in another station.

Mr. R. Orsettich referred to two great difficulties in the linking-up of stations, namely, that of the switchgear, which must be capable of standing the current of the combined systems, and the possibility of heavier surges than would occur in the systems when operated separately.

Dr. G. Kapp said he was not able to agree with the author's definition of "total synchronising power." Apparently the author took this to be the sum of the excess power given out by the leading machine and the deficiency of power in the lagging machine. He thought synchronising power should be defined separately for each machine. It was convenient to give the synchronising power in kw. per unit electrical degree phase difference between the two machines. Dr. Kapp also explained a diagram which he had devised for finding the total inductance for any ampere load on the machine. In conclusion, he added that when dealing with the induction motor and synchronising generator the author had pointed out that by making the slip fairly large it was almost impossible to overload the link between two stations,

and that a smaller set might be used than if both machines were synchronous. The two disadvantages mentioned were large differences in speed and a bad power factor. These, to Dr, Kapp, did not seem to be very serious, whilst the flexibility of the system and the freedom from dangerous overloading were very important advantages.

Dr. C. C. Garrard said that it was probable that the linking-up of the existing generating stations was the most immediate and practical step which the electric supply industry might take in the campaign of national economy which a prolongation of the war would entail. The success of such linking-up proposals would in a large measure depend upon the control gear, which must be chosen with regard to the maximum value of the short-circuit current which could occur in the place where the switches were situated. Even with the existing supply stations it was very doubtful whether the breaking capacity of the oil switches which were available had kept pace with the growth of the generating plant. They could conceive of two stations whose switchgear was adequate, having regard to the individual totals of plant installed; the effect of linking them up, however, by diminishing the inherent reactance of the system greatly increased the short-circuit current and rendered the whole of the switchgear inadequate. This trouble could be partially guarded against by the introduction of reactance in the interconnectors; but if they were to go in for large schemes of linking-up it would soon be found that the types of control gear available were inadequate, and this would prove a limiting feature. The largest types of oil switches hitherto made had probably been developed in America for overhead lines having comparatively large reactance values; it did not necessarily follow that the same switches would give satisfaction when used with underground cables, as would be largely the case with us. This question of control gear for very big supply systems was one which should be given special attention by the Institution. The American Institute had a Standing High-tension Transmission Committee, which was called upon to report periodically on the general progress of high-tension work. The Swiss Society of Electrical Engineers also did the same kind of thing, and he suggested that the Institution of Electrical Engineers should take this matter up. No action of the Institution could be more helpful in the advance of British electrical engineering than this. The present haphazard method of leaving it to the individual manufacturers and supply companies and corporations was very unsatisfactory, and a co-operative and co-ordinated effort was required. The V.D.E. had already issued a report upon this very question, but as far as he was aware nothing had been done in this country. It was essentially a question of research. Both manufacturers and users would heartily welcome any information on this subject. He suggested, therefore, that the Institution be asked to form such a committee with instructions to report, say, every six months. Such a committee would have to be thoroughly representative, and would not have to consist simply of a few worthy past-presidents and vice-presidents nominated in London. It would also have to spend a good deal of money, as experiments would have to be organised, &c.; moreover, in order to make rapid progress it would be necessary to retain the services of a good engineer to act as secretary to the committee. If such an organisation could be got to work, in a very few years the problems which were now a source of considerable anxiety to many supply companies' engineers would be solved and a great advance made in the reputation of British manufacturers of this class of apparatus. In view of recent announcements by the Government, it was very likely, if proper representations were made, that a grant of money from the Government for such a research might be procurable.

Mr. C. Jones, in a communication, wrote of the improvement he had been able to obtain in the power factor by the use of static condensers. In the particular system with which he was concerned three sets had been installed of 340, 400, and 600 microfarads capacity. These had been in use for twelve months without giving the slightest trouble.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Breakdowns of German Plant.

The articles on German plant contained in your publication last week have sent me to certain old letters filed away and almost forgotten, and as these deal in some of their paragraphs with the matter you are now discussing, they may be of interest to you.

I give below extracts from two letters after subjecting them to such sub-editing as is necessary to make a coherent story, but strictly retaining the sense of the originals whilst doing so.

"At the beginning of August we were informed that no more breakdowns should occur, so No. 5 generator burnt out its rotor that evening; a fortnight later it was running again and No. 3 generator burnt out its stator, the trouble being bad stator joints which set the insulation on fire. When No. 3 generator was repaired, No. 5 generator broke down again with a burnt-out stator and the core had to be rebuilt; No. 5 generator was back at work again only a few days when No. 1 generator broke down, owing to the rotor banding coming adrift. The air pumps have also given a lot of trouble, probably owing to light shafts. The five generators are built by ———, 10,000 KW., 1,000 R.P.M., 5,000 volts.".

"We have had a good deal of trouble on the cable system, the oil switches blowing up, and scattering the burning oil.

"At ——— sub-station a transformer broke down and was handed to the maintenance men; four of them were working on it, opening up, when there was an explosion and the men were enveloped in flames; one ran to the pond, but dropped dead a few yards away from it; another died during the day; of the other two, one may recover.

"A few days ago an oil switch burst at the same sub-station, and two men were injured."

The plant referred to has all been installed in a British colony and paid for by good British gold, and the whole of it was of German manufacture. The various breakdowns referred to in the letters were reported during a period of only a few months.

J. Shepherd.

Leeds, *December 4th*, 1916.

Trade with Italy.

During the last month we have received many catalogues and price lists from British engineering and electrical manufacturers; several of them mention that they had our address from page 484 of your Electrical Review of November 3rd, 1916.

We have pleasure in thanking you very much for your kindness, and we can assure you that we, since 1883, have done all we can to have machinery from England.

Cav. Alexander Hamilton & Sons.
John A. Hamilton.

Messina, *November 28th*, 1916.

The Recruiting of Skilled Engineers.

In one of the leading articles of your issue of December 8th you dealt with the calling-up of engineers skilled in the handling of Diesel engines. In the early days of the war the recruiting of trained men placed the nation in a very awkward position, and, in a number of instances, it was necessary to bring them back into civilian life. There seems to be a danger of these grave errors being repeated. Last week, before the City Tribunal, two engineers on the staff of a large insurance company, one an electrical surveyor, the other on the technical office staff, had their appeals for exemption rejected, apparently without any evidence being taken.

The importance of electrical work in the war is recognised even by the layman, and there is no class of men doing better service to the nation than the engineering staffs of insurance companies. They must have a wide technical and practical experience, be acquainted with every make and type of apparatus, and have a unique knowledge of power plants. Large numbers of controlled establishments, and thousands of firms doing work of national importance, are covered with insurance companies, and surveyors spend most of their time in getting these works out of trouble and preventing them from getting into it. As a matter of fact, even people who do not insure often retain these companies simply for the value of their inspections, tests and advice. In addition, the staffs do a lot of good work in the testing of machinery, both new and second-hand, previous to purchase, and also get out the plans and carry out the complete electrification of works. It must further be borne in mind that the companies themselves are not getting any extra premium, although large numbers of machines are working day and night, resulting in an increased number of breakdowns; in addition, the prices of repairs are more than doubled, and are nearly all class A or B.

If these men are to be taken away they should at least be put into positions where their services could be properly utilised. I doubt if this was the case as far as the two engineers mentioned were concerned.

Jaques.

The Armorduct Manufacturing Co., Ltd.

Mr. Nield, in his question in the House Commons on Monday last, of which you give an account in your last issue, refers to me as the nominee of the German shareholders. I desire to state that I am not, and never have been, their nominee.

I founded this business (at the age of 21), and when its development required capital took it from Germany when I failed to obtain it here, and your readers will hardly regard that as a crime. I tried repeatedly to replace this German capital by English capital, and failed owing to the antipathy with which industrial investments were regarded in this country prior to the war.

The Board of Trade Parliamentary Committee, with the full knowledge of all the facts and of my history, invited me to make an offer for the alien interests of the company; I have made this offer, and, whether it is accepted or rejected, I have acted throughout in the best interests of the country of my adoption.

W. Ratcliffe-Small.

London, E.C., *December 12th*, 1916.

Australian Postal Contracts.

Referring to the paragraph under this heading which appeared in your issue of September 1st, I beg to advise you that although, after three months' delay, the Postmaster-General's Department replied to a communication dated October, 1915, giving reasons why an arbitration clause, or its equivalent, should be inserted in contracts, intimating that it had been decided not to vary the conditions of contract in regard to the rejection of material by making provision for the appointment of a Survey Board, Clause 10, which provides for a Survey Board, has been inserted in a large number of contracts entered into by the Department with members of my Committee since this date.

R. H. Butler,
Secretary, the Australian Electrical and Allied Contractors' Committee.

Melbourne, *October 20th*, 1916.

BREAKDOWNS OF GERMAN PLANT.—If our other correspondent in Leeds will forward his address, in accordance with the rule at the head of this section, we shall be pleased to insert his letter on this subject.—EDS. ELEC. REV.

NATIONAL INSURANCE (UNEMPLOYMENT) ACTS, 1911—1916.

UNEMPLOYMENT INSURANCE.

Decisions by the Umpire.

A. THE Umpire has decided that contributions are payable in respect of :—

2,072 X. Pointsmen, signalmen and other workmen engaged in regulating traffic at factories engaged wholly or mainly in munitions work, or in any trade insured under the National Insurance (Part II) (Munition Workers) Act, 1916.

2,076 X. Workmen engaged in the preparation of slate for electrical appliances, tanks, or vats for use in the manufacture of munitions of war.

2,078 X. Workmen (including stranders and coverers) engaged wholly or mainly in making telephone cords.

2,079 X. Workmen engaged wholly or mainly in covering metal wire with silk, cotton or other material.

B. The Umpire has decided that contributions are *not* payable in respect of :—

2,077. Workmen (other than those insurable under Part II of the National Insurance Act, 1911) engaged in the repair of bridges which are built up on the site.

LEGAL.

BRITISH-THOMSON-HOUSTON CO., LTD., *v.* DURAM, LTD.
TUNGSTEN WIRE PATENT LITIGATION.

(*Continued from page* 626.)

MR. SWINBURNE said he had made himself acquainted with the specifications in the case. With regard to Siemens's German specification of 1902, that dealt with tantalum, niobium and vanadium. Any knowledge about those metals would tell them nothing as regarded the working of tungsten. The same applied to the Abel specification of 1900, which also dealt with these metals. The specification of the British Thomson-Houston Co. of 1906 stated that "difficulty has been encountered in drawing or rolling filaments from tungsten, because of its non-ductile character as ordinarily obtained." "We have discovered that when tungsten is heated it undergoes remarkable molecular changes, and, in fact, becomes so ductile that it may be easily worked when hot." "The metal becomes so ductile that it may be hammered into bars, rolled into sheets, or drawn through dies into wire." The process was described in the specification, and he had seen the process actually carried out. It was an important process for lamp filaments, and was practically replacing all the others, and the metal was coming into use for other purposes as well, such as making electric spark contacts. He had not found in any of the earlier documents pleaded in this case instructions which would enable him to work tungsten.

Witness was cross-examined by MR. TERRELL, K.C., with reference to the meaning of malleability in metallurgy, and also with regard to the ductility of certain metals. Counsel suggested to witness that it was found impossible to make tungsten for a lamp unless it was got coherent. Mr. Swinburne agreed, and also assented to counsel's remark that when it was first made coherent it was by the same process as osmium. The built-up tungsten filament first got on to the market about 1907, and the drawn-wire filament much later.

Can you account for the fact that it was not brought on to the market between 1906 and 1911-12?—From 1906 to 1911 is five years and that is not out of the way for developing a process like this into commercial work. It is not that you have to draw the wire and make a new lamp, to compete with gas, or something of that sort, you have to compete with an existing lamp; you cannot get it into commercial use till you are better than the existing lamp.

On December 6th MR. SWINBURNE continued his evidence for the plaintiffs.

MR. T. TERRELL, K.C., in further cross-examination, suggested that there was a difference between ductility and malleability.

WITNESS said, in his opinion, ductility involved malleability plus tensile strength. This specification did not talk of malleability.

When you heat the metal and start hammering it, there is no more ductility in the metal than there was before you began in the sense of differentiating it from malleability?—I think there is; I think the hammering generates ductility. Mr. Swinburne also said that, in his opinion, the word "ductility" was used loosely to mean workable.

Prof. C. V. BOYS, F.R.S., said he had read and considered the specification of the plaintiffs, and took part in certain experiments with reference to the subject matter of the patent. The information on the subject of tungsten at September, 1906, the date of plaintiffs' patent, consisted of Moissan's experiments. Tungsten powder was well known at that time, and possibly the squirted filaments of tungsten; but he was not sure that they were on the market then. Asked as to the possibility of investigating the malleability and ductility of tungsten from the then known materials available for research, witness said it was possible to repeat the experiments of Moissan, and to get his result. As to the filaments, they were a finished product, and owing to its brittleness and hardness he would never think of drawing it. He did not know of any tungsten which could be put into the form of rods. Dealing with the Siemens specification, Counsel asked if there was anything in that document which would be helpful to a man who was facing the problem of making tungsten?—Witness said they could gather nothing about tungsten from other metals. The document told them nothing in words and nothing by inference.

HIS LORDSHIP: Suppose you take a fritted tungsten rod and expose it to further prolonged heating, do you increase its malleability apart from any subsequent working or heating?—I think that is the case; the greater the temperature and the greater the length of time you maintain it, the more coherent and compact the metal becomes.

Cross-examined by MR. KERBY, K.C., for defendants, who asked what directions the specification of plaintiffs gave for working tungsten for other purposes than wire drawing, WITNESS said they could roll it into sheets.

You have seen experiments; do you think it can be hammered into bars, proceeding according to the specification?—I believe I can hammer it, working very carefully; but I think rolling is vastly better and quicker.

In September, 1906, if you had wanted to get a piece of tungsten rod, it was the obvious thing to get it from the powder by the squirting process?—If you wanted to do it, you could try the squirting process with tungsten.

In September, 1906, was there a difficulty in producing a built-up tungsten rod?—I do not know of its being done; but, if it had been tried, it would have succeeded.

As to the patent in question, at what stage in the process of rolling or drawing do you say the slug becomes ductile?—It may be that it is ductile before you roll it at all; I have not tried that; but as ductility requires a greater degree of strength and coherence than mere malleability, and you roll before you can draw, the process may be a gradual one.

On December 7th, MR. SWINBURNE was re-examined, his evidence having been interrupted on the previous day by an Admiralty engagement.

MR. WALTER, K.C.: From all the literature you knew until the instructions that were contained in this specification, did you know of any coherent form of tungsten?—No.

In the treatment of the powder which has been carried up to 1,000 degrees in the manner indicated in the specification, does that produce a different physical condition in the rod?—It does.

What is the general character of the change that has taken place?—A reduction of the dimensions of the body; that is to say, it gets smaller, and the particles come together so that they appear to be quite solid.

Do you know of any method by which tungsten can be obtained in a molten form, so that it could be formed into rods?—No.

As regards the nature of the operations, rolling, hammering, and so on, what is the preliminary to work such as Mr. Terrell spoke of?—In modern days all the metals used have been melted first.

Could such experiments have been carried out with tungsten up to the date of this specification?—No; you could not get tungsten, to start with, into the regular condition. Witness further stated that the prior specifications relied on by the defendants, dealing with the treatment of other metals, afforded no instruction as to the treatment of tungsten.

HIS LORDSHIP: Having read plaintiffs' specification from a scientific point of view, does it convey to you as a metallurgist that he is disclosing a method for dealing with a molten tungsten?—No; it conveys this idea, that you can take a powder and make it into a sufficiently coherent and solid form for working.

DR. PASSMORE, the well-known chemist, gave evidence as to experimenting with tungsten according to the process of hammering described in the specification. He satisfied himself, he said, that the coherent product as described when heated to a red heat only oxidised to the extent of bluing on the surface. All the tungsten he had hitherto worked with immediately on heating long below red heat oxidised. That was then his knowledge of tungsten. As to the effect of hammering, he took a slug made from the coherent process, and put it on a sheet of thin

flat iron, resting it on a sheet of asbestos, and he was able to flatten it out. He tried to work tantalum by the process indicated for the working of tungsten; he took the tantalum in the condition of powder, mixed it with glutinose, made it into a rod, heated it to 1,000°, or thereabout, and then, hanging it up, tried to pass an electric current through it, and could not do it, the reason being that the metal contained some oxide. Dr. Passmore next gave his views on the methods described by Moissan with regard to tungsten.

The plaintiffs' case was closed, and MR. COLEFAX, K.C., summed up the evidence on this side.

On December 8th, MR. TOM TERRELL, K.C., opening the defendants' case, said the fair reading of the evidence was that there had never been made a tungsten rod of anything like three-sixteenths diameter.

His LORDSHIP said he was not prepared on the evidence to say that making that was not an invented novelty.

MR. TERRELL said they presented their case on this footing, that the patentees only put into practice a discovery, which discovery it was the business of the ordinary metallurgist to make in connection with either a new alloy or a new metal. That being so, and there being no difficulty and no suggested invention in carrying it into operation, there being no special apparatus necessary to do it, the only invention could be the bare application of the discovery that was alleged to be made. That discovery was the business of the ordinary metallurgist and was not invention. The evidence of Mr. Swinburne established this, that given a chunk of tungsten, a metallurgist engineer being told to investigate its properties would, as a matter of ordinary business, try it cold and try it hot to find out its properties. He might be deceived about the tungsten, but he would find out, as part of his business, that it was malleable hot. There was no subject matter in the patent, because a so-called discovery could not be subject matter, and there was no invention or pretended invention in the application of a discovery. All that was said to flow from the discovery was that which flowed admittedly from the same fact in other metals.

On December 11th, MR. BALLANTYNE, expert chemist, examined by MR. KERBY, K.C., for defendants, said he had been in a number of these wire cases, and he had read the specification in this case. He remembered the proposal for the tungsten filament lamp. Before that, so far as he was aware, there was no use for tungsten except in the form of powder.

Was it known before the success of the filament lamp that wire made of tungsten would be a success for lamps?—That was believed up to 1904, and in 1904 we knew it when the built-up filament was a success. The patent became known in 1905. In September, 1906, he published in the *Journal of Chemistry* a *précis* of a communication in a German paper describing the lamps generally.

What to you, as a chemist and practical scientific man, does the specification in this action suggest as an invention?—I had a little difficulty at first in understanding what the point of the inventor was. At first I understood it was in order to get ductility by a process of heating, but I gathered afterwards that it was the working of a metal by melting.

What material did you understand to be referred to?—I understood it to be tungsten, which had started in the form of powder, and was converted into the form of a coherent. He added that he understood that it was necessarily started in the form of a powder, and if that could be melted it would produce tungsten in a coherent form. He could not say he knew, as an actual fact, that melted tungsten was on the market, but he believed tungsten had been used on the market in a form suitable for making filaments. He had tested the slugs which were made according to the patentees' process, and found the density to be in one test 16·7 and in the second test 16.

(To be continued.)

HENDON ELECTRIC SUPPLY CO., LTD., *v.* COLLINS.

AT the Hendon Petty Sessions, on November 30th, Miss M. G. Collins, of Hampstead Garden Suburb, was fined £5, and £2 2s. expenses, for stealing electric current, value 5s., the property of the defendants. The company charges 1½d. per unit for heating and 5½d. for lighting, and the evidence given for the company showed that by means of a long flexible cord extending from one room to another, and a lighting socket attached to the heating plug, defendant was using heating current for lighting. Mr. J. M. Lickfold, who appeared for the prosecution, said that the company was proceeding in a number of similar cases, as this kind of thing appeared to be largely carried on in the district.

ELECTRICITY WORKS EMPLOYES' LEAVING CERTIFICATES.

TWO electrical engineers, employed by the Islington Borough Council, who appeared before the London Munitions Tribunal, said that they had asked for their leaving certificates because they had been refused the 3s. war rate granted to engineers on November 7th. Unless they obtained the extra 3s. or left the employ of the Council they would be turned out of their Trade Unions. ALD. SAINT stated that each man was getting an average wage of £2 10s. per week, and the Council desired to pay fair wages. The Council were supplying electrical energy at 1d. per unit, and were making no huge war profits. Neither did the men have to work under high pressure. If the wages were raised, the increased working costs would mean that the rates would have to bear part of the cost of running the business. The case was adjourned in order that the representatives of the men's Trade Union might be called.—*Daily Telegraph.*

MAYLE *v.* HOBART MANUFACTURING CO.

IN the King's Bench Division, on December 6th, before Mr. Justice Rowlatt and a special jury, plaintiff, a pork butcher, of Harringay, sued the Hobart Manufacturing Co., of Charterhouse Street, City, to recover damages for injury to his right hand, caused, as he alleged, by the negligence of the defendants' servant. It appeared that on December 7th, 1915, plaintiff visited the Cattle Show at the Royal Agricultural Hall, Islington. The defendants, who are manufacturers of sausage-making machines, had a stand. The plaintiff, on going round the stalls, was invited by one of the defendants' servants to examine the sausage-making machine, and the plaintiff put his right hand into it, being unaware of the fact that the machine was actually working. The result was that the top portion of the index finger and part of the second finger on the right hand were cut off. He claimed damages, alleging that no warning was given to him that the machine was working, and that he should not place his hand inside it. The plaintiff, as a pork butcher, was permanently disabled in the use of his right hand, and he had lost the situation he was engaged in at the time. The plaintiff claimed damages and loss of salary. The defendants denied that the plaintiff was invited to examine the machine, and they said that the plaintiff was negligent in putting his hand into the machine. The defendants denied negligence.

MR. MARRIOTT, in opening the case, said that the machine in question was worked by electric power, started by a switch on top, and counsel suggested that the defendants' servant must have turned on the switch just as the plaintiff put in his fingers.

The PLAINTIFF, who is 30 years of age, gave evidence in support of his case. He said he was definitely invited by the defendants' servant to enter the stall and inspect the machine. He was proceeding to inspect the "worm" to see if it was tight; the machine was not working at the moment, but suddenly it started, and off came his fingers.

Evidence having been called for the defence, the jury awarded the plaintiff a total of £60 15s., and judgment was entered accordingly, with costs.

A. P. LUNDBERG & CO. *v.* WITTING & PARTNERS.

IN the King's Bench Divisional Court, on Thursday, December 7th, Justices Ridley and Avory heard an appeal by the defendants against a decision of the Judge at Clerkenwell County Court in respect of a disputed contract for 180,000 mild steel grub screws.

MR. FORTESCUE, for the appellants, said the appeal was in respect of an action respecting an order for 180,000 screws ½ in. long—¼-in. Whitworth thread—to be delivered by plaintiffs to defendants at the rate of 22,000 weekly. The action was brought to recover £42 5s., the price of certain of the screws. In the Court below the defence was that the screws were not in accordance with the contract, and defendants contended that they were entitled to regard them as worthless. There was a counterclaim for loss of profits and costs of stacking up machinery. The Judge found that there was a breach of contract, and that the screws were not in accordance with the sample. But he held that in the circumstances the people to whom the screws were to be delivered did not reject them within a reasonable time, and, therefore, they must pay the full purchase price of the screws. He also dismissed the counterclaim.

MR. PALMER, for the respondents, argued in favour of the finding by the Judge.

The Court allowed the appeal, with costs, and ordered a new trial. There was no doubt the screws were to be made to a certain pattern, and that they were not according to that pattern. The Court said the learned Judge was right in his first finding, but was not correct in the second.

EDISON SWAN ELECTRIC CO., LTD.

ON Tuesday, a petition by this company, for the sanction of the Court to special resolutions altering the objects of the company, was heard by Mr. Justice Neville in the Chancery Division.

MR. JENKINS, K.C. (for the petitioners) said that his clients had very large and complete plant, and they desired to extend their powers by entering into arrangements with the Government and municipal and other authorities, and doing any engineering work that was submitted to them. They also desired power to acquire patents for inventions relating to mechanical engineering, chemistry, chemical engineering, and anything of a like character in addition to their electrical patents.

His LORDSHIP granted the petition.

THE RATING OF ELECTRIC TRAMWAYS.

THE assessment appeal of the L.C.C. was further heard on Tuesday, and the Court announced its intention to deliver judgment on December 21st.

Electrical Engineer Sentenced.—William Edward Mills (39), formerly holding a prominent position in the Birmingham Corporation Electric Supply Department, and latterly an officer in the R.N.V.R., has been sentenced to six months' hard labour at the Crown Court of Birmingham Assizes, on a charge of assaulting Violet Curtis, aged 14, and to a similar sentence on other charges, both sentences to run concurrently.

WAR ITEMS.

Appreciation.—A correspondent with the British Expeditionary Force, writing under date December 5th, 1916, says:—"The weekly copy of the REVIEW still reaches me regularly, and I am duly grateful for your kindness in sending it. As the means of keeping one in touch with everything that is going on in the electrical world, it is a truly valuable and welcome link."

Munitions Priority Branch.—The Priority Branch of the Ministry of Munitions, whose offices are at St. Ermins Hotel, with Mr. Edgar Jones, M.P., at the head, will have charge of machinery for controlling the use and distribution of metals under the new committees that have been recently appointed for effecting economies in metals.

A Copper Committee.—It is announced that the Ministry of Munitions has appointed Mr. Cecil Budd, of Messrs. Vivian Younger & Co., London, and Mr. R. H. Rucker, of Messrs. Henry Rodgers, Sons & Co., London, as a Committee to advise the Ministry on the purchase and distribution of copper. Mr. Budd is chairman of directors of the London Metal Exchange, and Mr. Rucker is chairman of the Metal Exchange. Mr. Stroud, of Messrs. Charles Tennant & Co., will act as secretary to the Committee.

An Example to Follow.—The employés of the Birmingham Corporation Electric Supply Department at the outbreak of the war instituted a war relief fund, to which they have contributed over £1,000. Each Christmas they have sent to the men on service a Christmas present, and are doing the same this year. The men abroad will receive a parcel containing some dainties, and the men on home service will receive 5s. each. The wives of each of the men will also receive 5s., and 1s. for each child over 12, and a toy for each child under that age.—*Birmingham Post.*

Walther Rathenau Again.—An Exchange dispatch from Paris quotes the *Journal*'s special correspondent at Zurich to the effect that in the course of the general meeting of the Allgemeine Elektricitats Gesellschaft, at Berlin, the chairman, Herr Walther Rathenau, known as the chief organiser of raw materials during the war, said:—

"Even those who make no mistake about the reality of the political and military situation have now the impression that for the first time for a very long while a distant glimmer of peace appears, but no hope should turn us from our duty. We must continue to extend our war factories, and build new ones, in order to increase our production. You know that Hindenburg's strong programme calls for the entire forces of the country, and the immense tension of these forces should turn Germany into one great arsenal. It is no longer a war of one army against another, it is a war of material. Our adversaries say that time works for them. No. Time works for no one; time fights against all."

Coal Supplies Held Up in France.—While the price of coal in France, writes the *Financial Times* Paris correspondent, ranges from £6 to £8 per ton, thousands of tons of coal continue to lie idle in French ports for lack of available transport. According to the *Petit Parisien* there are 800 barges containing 300,000 tons of imported British coal, unable to move for want of tugs. At the pit mouths of French collieries 500,000 tons lie waiting for transport, and a further 300,000 tons lie at various seaports. Meanwhile a number of important munition factories are working short hours owing to the lack of coal. The trouble arises in great part from the military control of the railways, the military authorities unnecessarily holding up large numbers of empty trucks for several weeks at a time. Speculators are taking advantage of this disagreeable—and, under existing circumstances, dangerous—condition of affairs, and quite recently a large coal dealer was able to exact the price of £9 1s. per ton for an immediate supply of 250 tons of coal. This price constitutes a record, even for France.

Germany and After-the-War Trade.—Mr. Gerard, the U.S. Ambassador to Germany, before leaving America on his return to Germany, delivered at a New York dinner an interesting speech on enemy after-the-war plans. According to Reuter, he said that in Germany, after the war, probably no one will be permitted to purchase anything made outside of Germany. There will be, in all probability, a central buying committee, which will do the purchasing from foreign countries for the Empire. This will permit the Germans to enter the markets in a position to say to a certain extent what prices they will pay for that which they wish to purchase. . . . If our peace and prosperity are to continue commercially, permission to combine for the foreign export trade should be given. Mr. Gerard thought that in every foreign nation after the war there would be similar central bodies for commercial protection and to reap commercial advantages, and these were the matters the States had to meet. At another point in his speech Mr. Gerard said that if America was to give the eight-hour day they had got to give the manufacturers and the working men some measure of defence against those countries where the working man worked 10 hours or more, and where so many women worked and had assistance furnished them.

Australia and Munitions.—In a recent speech at Melbourne, forecasting national organisation, the Minister of Defence (Mr. Pearce) said that they could not continue putting steel and iron into ornamental work when it was required for guns and shells.

War Bonus.—It was announced on the 9th inst. that a further war bonus of 3s. a week is to be granted to Sheffield Corporation women car conductors and other tramway employés receiving less than 48s. per week, at an annual cost of £15,000. War bonuses will now cost the tramways department £36,610 per year.

Tramways and Excess Profits Duty.—The Board of Referees, in response to an application by Auckland Electric Tramways Co., Ltd., have increased the statutory percentage in their case to 7½ per cent. in the case of a trade or business carried on or owned by a company or other body corporate, and to 8½ per cent. in the case of any other trade or business.

Export Prohibitions.—The list of export prohibitions has been amended, and particulars of the alterations appear in the *London Gazette* for December 12th. The following headings are to be deleted from the schedule:—

(B) Electric lamps, except carbon-filament lamps and arc lamps for street lighting.
(C) Pocket lamp cases and cases fitted with bulbs but not containing batteries.
(B) Lead, pipe, scrap or sheet, and solder containing lead.
(A) Valves, gas, steam, and water.
(A) Wood screws, made of brass, iron or steel.
(A) Peroxide of manganese.

The following headings are to be added:—

(A) Manganese, peroxide of, and mixtures and preparations thereof.
(A) Zirconium compounds.
(B) Electric lamps, except carbon-filament lamps, arc lamps for street lighting, and pocket electric lamps and their component parts.
(C) Electric lamps, pocket, and their component parts.
(A) Fuel economisers constructed of cast iron pipes, used as auxiliary heating apparatus in connection with land or marine steam boilers.

Metals and ores as follows:—

(C) Iridium, osmium, palladium, rhodium, ruthenium, and alloys of these metals.
(B) Lead (except pig lead), alloys of lead, solder containing lead, and manufactures of lead or its alloys, not otherwise prohibited.
(A) Thorium and its alloys.
(A) Zirconium and its alloys.
(A) Thermometers.
(C) Valves, gas, steam, and water.
(C) Wood screws, made of brass, iron or steel.
(B) Zirconium minerals.

Exemption Applications.—At the Aberdeen City Military Tribunal, Messrs. Bell & Lyon requested exemption for John Torn, apprentice engineer. It was suggested that a handyman might be got for the work being done by the apprentice. Mr. Bell said they could not get a man in the city. Mr. McDonald said he was told the Electrical Union was very severe. Mr. Bell said there was to be a deputation meeting this week about that, because there were one or two men engaged in Aberdeen who were not in the Union, and they were threatening to call out the rest of the men. The Chairman: I hope you will make a representation to the Ministry of Munitions if they attempt to carry out any threat of the kind. They will not stand any nonsense of that sort just now. Mr. Bell: We are entirely in their hands at the present time. Temporary exemption for two months was granted.

At Stoke-on-Trent, on December 6th, Mr. W. Thorn, manager of the Potteries Electric Traction Co., asked for reconsideration of an order that the company should surrender 38 men, in two instalments of 19 each. The first 19 had been released, and if the others had to go it would be impossible to maintain the whole of the services now running. To produce the other 19 men would mean drawing a very large number from running shed repair staffs, which were already depleted. He added that a high percentage of the passengers were workpeople and munition workers. The Tribunal decided to refer Mr. Thorn to the Military authorities, stating that the Tribunal had no objection to the retention of the men by the company if the Military were of opinion that they should be retained in their present occupation.

Certificates of conditional exemption have been granted to Messrs. A. A. Gates (26), managing clerk, and H. J. Russell (25), engineer's turner, appealed for by Messrs. Christy Bros. and Co., Ltd., electrical engineers, of Chelmsford.

At East Grinstead (Sussex), an appeal was made by Mr. J. H. Novis, electrical engineer, now engaged in making aeroplane fittings. The Tribunal decided to ascertain from the Ministry of Munitions whether a place could be found for appellant in munition works, or whether he could be allowed to remain in the district provided he continues his present work.

Before the Romford Rural Tribunal, on December 5th, Mr. J. W. Millar (39), electrical engineer to the Barking Chemical Co., appealed on the ground of national interest and certified occupation. The appeal was supported by the company, and

the Tribunal allowed appellant 14 days in which to find work of urgent national importance.

At Aldershot, on December 5th, Mr. Vertue (36), electrical engineer and contractor, passed for general service, renewed his appeal for exemption. He said that the circumstances were similar to when he last appealed, except that he had now only one of his original staff left, who had been rejected. He had considerably more plant to look after personally, and he had practically to confine his work to the maintenance of motors in order that the machinery of various firms might be kept running. He contended that it was in the national interest that he should continue in the business. Exemption was renewed.

The Southampton Tribunal has refused exemption to the electrical engineer at a local gunpowder factory, it being ascertained that the firm were solely making gunpowder for sporting purposes.

The Southampton Corporation Tramway Committee appealed for the retention of four married motormen, all of whom had been previously rejected. The Chairman: Are the Committee considering women as drivers? It is being done in other places. Ald. Dunsford: We do not want to do it. It is not women's work, especially through the streets of Southampton at the present time. Each of the men was exempted for three months.

The Salisbury Electric Light Co. appealed for a chief clerk and accountant. The manager said that he had made efforts to find a substitute, but without success. Exemption to March 1st was conceded.

Watford Tribunal has granted exemption to February 1st to G. Wall (30), foreman for the British Battery Co., Ltd., who appealed for his retention.

At Watford, the U.D.C. appealed for W. E. Field (30), stoker at the refuse destructor. The Military Representative said the man ought to be replaced. Three months were granted.

At Berkhamsted, Mr. A. E. Barren appealed for W. Meager (35), electrical engineer, of Potten End, who superintends the boilers and electrical arrangements at the house. Exemption was refused.

The Driffield Tribunal has granted exemption to March 1st to the electrician at a local picture palace.

Before the West Kent Tribunal, the Erith U.D.C. defended six months' exemption to E. G. Tapp (23), motorman on the tramways, opposed by the Military Representative, who said that a single man in Class B1 should not be left out of the Army. The tramway manager (Mr. Williams) said that the police would not licence a man under 20 or women as drivers. The tramway department had been certified as of importance for carrying on munition work; 75 per cent. of the 18,000 daily passengers were munition workers. The Chairman: Why don't they badge these men? Mr. Atkinson (Clerk to the Council): I think there is a scheme on foot. The Tribunal allowed the appeal, and directed that the man should not be called up before December 31st.

At Rochdale, Mr. G. L. Adamson, electrical engineer, withdrew an appeal for J. Heywood, aged 36, an electrical wireman, who had been badged.

At Rochdale, the Tramways Committee appealed for W. Brierley (28), married, coach body painter, and F. Travis (29), married, tramway traffic clerk, both passed for general service. Mr. G. Webster, the general manager, said Brierley was now practically engaged in repairing lifeguards, and Travis was the senior traffic clerk; all the men in this particular office had gone except one. Mr. Webster said that, on the whole, female conductors were satisfactory. Both appeals were refused, but time to January 31st was allowed.

During the application for two Corporation Clerks at Darwen, a member of the Tribunal said women were doing work in the town. The head of the department who was making the application observed, "Last month you said we had women on the cars. One of them jumped from a car when it was in motion, with the result that we have to pay compensation." One clerk was exempted, and the other allowed until the end of January.

At Oxford, the Electric Light Co. appealed for temporary exemption for F. E. Talbot (27), chief clerk, who has been with the company for 13 years, and was claimed to be indispensable. It was stated that the company had no desire to keep men out of the Army, but the financial year ended on December 31st, and Talbot was invaluable for that purpose. Four of the clerical staff of five entered the Army at the outbreak of war, and Talbot himself was anxious to go, but he was starred. The Substitution Office had frankly owned that they could not find a substitute. Captain Fox said that exemption till February meant a waste of three months. That was all very well if the war was going on for ever; but if they were going to finish it up next year three months was a serious matter. Talbot was a skilled man, and since the development of the air service skilled men were required. Mr. F. Gray (for the company): This man is not a mechanic. Captain Fox: I'm sorry; I thought he was. Cannot his work be done by a woman? Talbot: Not very well. Mr. Eeles, secretary to the company, said that Talbot was the only male clerk left. As he was starred they thought they would have him to the end of the war, and that was the reason they had not trained anyone to take his place. It was agreed that Talbot should have temporary exemption to February 1st.

The West Kent Appeal Court, on December 5th, granted exemption until December 31st to Mr. H. Somers (36), electrical engineer, of Anerley.

Before the East Kent Appeal Court, on December 6th, the Military successfully appealed against exemption allowed to Mr. S. W. Board (23), electrician, of Ramsgate, who is an auxiliary fireman, but he is not to be called up until February 6th.

At Weymouth, the T.C. appealed for the retention of two skilled labourers at the refuse destructor. The eldest was given until March 31st, and the other to the end of the year.

Reading Tribunal granted six months' exemption, on his taking up munition work, to J. Picket (38), electrical fitter with Messrs. Baughan & Co.

An electrician in business at Epsom applied, on November 29th, for extended exemption on the ground of business hardship. He is passed in Class C2, and stated that every effort had been made to dispose of the business, but without success. Two months were conceded.

At Mansfield, the Tramway Co. sought conditional exemption for a motorman named Walter Arbon (27), a skilled driver on a difficult route, and the appeal was assented to.

Before the Droitwich Rural Tribunal, Mr. Bruce Ward, of Westwood Park, claimed the retention of his electrician, G. M. Trigg (32), passed for general service, and he was given until January 1st.

An appeal by W. J. Watkins (23), engaged at the London Electrical Wire Works, has been respited by the Essex Tribunal for 14 days to allow him to obtain substitution work, failing which he must join up.

At Southport Tribunal, Mr. A. S. Black, the Corporation electrical engineer, appealed for a wireman, aged 40, married. Mr. Black, in reply to the Military Representative, said that he had seventeen who had special certificates from the Minister of Munitions; seven were over military age. The Military Representative said a strong case would require to be shown why this man should not go. Mr. Black said that if the staff were further reduced, the undertaking would get into a dangerous condition. The man applied for was kept for the maintenance of consumers' installations, and he could not replace him. Exemption to March 1st.

BUSINESS NOTES.

The "Electrical Review" for December 29th.—In consequence of the Christmas Holidays our Advertisement Department requests advertisers to send in their new advertisement copy and alterations to existing displayed advertisements intended for the issue of the ELECTRICAL REVIEW for December 29th, by Friday, December 22nd. We shall be glad if our correspondents and other contributors will also send in their matter at the earliest possible moment.

Export Prohibitions.—The *London Gazette* for December 8th contains further lists of bodies and persons with whom trading is prohibited in Argentina and Uruguay, Brazil, Chile, Denmark, Netherlands, Portugal, Spain, Greece, and other countries.

Business Prospects in China.—Some notes from a recent report by H.M. Consul-General at Hankow, appearing in the *Board of Trade Journal*, show that the value of imports of electrical materials and fittings declined by 97,000 Hk. taels in 1915, as compared with 1914. This decline was not due to a falling off in the demand for up-to-date lighting, but to the difficulty in getting orders filled as well as to the increased cost. When conditions return to normal there is sure to be a great expansion in the demand for all kinds of electrical materials from all over China. A decline in the importation of machinery to the value of 700,000 Hk. taels was also due to the abnormal conditions, and not to a lack of demand. Many new enterprises in Hankow are contemplated in the near future, but the present time is not considered propitious for making purchases, and deals are being put off to a more favourable opportunity. There is a good demand for electrical and other machinery, but the high prices ruling, and the impossibility of guaranteeing early delivery, prevent much actual business being done. Before the war a large proportion of these and other goods were imported from Germany or Austria. Supplies are at present being obtained mainly from Japan and the United States.

Book Notices.—*Manual of Electrical Undertakings and Directory of Officials.* By E. Garcke. Vol. XX. 1916-17. London: Electrical Press, Ltd. 21s. net. Owing to war conditions, the production of this work has been delayed beyond the usual date, but in regard to its contents there is practically no change in the main features, excepting that the delay has made it possible to include later financial information, which is something to be thankful for. Nearly all the customary statistical tables summarising the progress of the industry are included, and the "Survey for the Year" indicates the very highly-increased service which the electrical industry has been able to render under war conditions, though only a moderate amount of fresh capital has been introduced. The increase in kilowatts connected by both supply companies and municipalities is less than in the preceding year, but there has been an increase in output among the companies of 125,000,000 units as compared with an increase of 33,000,000 a year ago. The municipalities also show an increase of 183,000,000 units as compared with 25,000,000 a year ago. These figures indicate the

extent to which the marginal capacity of supply undertakings has been encroached upon by the necessities of war. In regard to electrical manufacturing, the statistics given show that the average return of all the undertakings of which returns are available has fallen from 6·73 per cent. to 6·15 per cent. ; the companies included are, of course, in some cases engaged also in non-electrical work, so that the revenue is derived from both electrical and non-electrical sources. Particulars are given of 2,650 electrical and allied undertakings representing capital amounting to 481 millions sterling. There is a large map of the United Kingdom showing all the traction, light and power undertakings. The account of the progress of the year occupies 100 pages, and among other matters dealt with are imports and exports, prices of investments, and financial information concerning German electrical and allied companies such as have formed a regular feature of our City columns for many years past, and of which a word later. The largest section (1,000 pages) of the volume is that giving statistical and general records of lighting, power and traction undertakings ; telegraph and telephone concerns, manufacturing and miscellaneous, Colonial and British possessions, are also usefully covered in separate sections ; and, finally, there is the usual directory of names and addresses of 20,000 officials. The twentieth edition, as a whole, well maintains the high reputation that previous volumes of the Manual have won for it. We have, of course, not examined the contents in detail, but in regard to the tabular information relating to German electrical and allied companies, which is reprinted by permission of the Export Department of the B.E.A.M.A., who compiled it, it might not have been bad policy to have asked the Association to revise the proofs ; however, the names are sometimes rendered correctly. Obviously, as the publishers themselves say, the difficulties attending the production of statistical records have been abnormally great during the past year.

General Cargo : an Introduction to Salesmanship. By R. E. Goddard. London : Constable & Co., Ltd. 4s. 6d. net. The author of this book is foreign sales manager to Messrs. Humber, Ltd., of Coventry, and as the result of experience gained in the principal countries of the world, he has collected the information here imparted for the assistance of those who desire to make an effort, after the war, to get back some of the losses caused by the war. After discussing the universality of trade, he shows, in a chapter on the factory, that behind all our foreign trade preparations we must have a thoroughly efficient factory organisation. The only way to bring money into the country is by seeking fresh outlets for foreign trade ; the only way to restore our credit is to redouble our exports. The manufacturer must not regard his foreign orders as a windfall, but should make definite plans as to how much of a given output he intends for export, and should modify the export portion, so as to produce goods suited for particular markets. This leads the author on to a consideration, in two chapters, of many points in regard to the export department. Five chapters discuss the following markets, and their requirements :—Europe, Asia, Australia, Africa, South America, the West Indies and the Pacific. Later the qualifications of the foreign representative are discussed, also the manner in which he should conduct himself, and his operations when following his occupation among many very different nationalities. It goes without saying that any man before trying to establish connections with races whose manners and customs and tastes are so different from those of Home, should educate himself as thoroughly as the available means allow in regard to these and other local characteristics. The best *modus operandi* for the *permanent* representative or agent who is sent out from home to live abroad receives attention, and in a final summary three methods of procedure in obtaining foreign trade are stated. First, foreign traders may be circularised, advertisements may be placed in foreign journals, and the results awaited ; secondly, arrangements may be made with some recognised house of export agents at home ; but lastly, and best, is the sending out of one of the manufacturing heads, or a good representative, armed with samples, to study the markets and fix up agencies direct. This method is, of course, the most expensive, and in our opinion it requires to be preceded by the first-named method in order that the way may be prepared in advance, but the ultimate gain from such personal efficient study of markets will be found to be far greater than in the case of either method one or two alone. The book is a timely one, and those who contemplate launching out may find in it many useful pointers.

"*Journal* of the Institution of Electrical Engineers." Vol. XLV, No. 261. London : E. & F. N. Spon, Ltd. Price 7s.—The issue for December contains the following lectures and papers :—"Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell ; "Theory of Armature Windings," by Dr. S. P. Smith, and the inaugural addresses by Prof. D. Robertson and Messrs. H. A. Nevill, A. E. McKenzie, and J. K. Stothert ; also a ninth list of the names of 119 members on military service.

"Handbook of Machine Shop Electricity." By C. E. Clewell. London : Hill Publishing Co. Price 12s. 6d. net.

"Applied Electricity for Practical Men." By A. J. Rowland. London : Hill Publishing Co. Price 8s. 4d. net.

"Electrical Engineering." By E. J. Berg. London : Hill Publishing Co. Price 15s. net.

"Science Abstracts." Vol. XIX. Part 11. (A and B.) November 25th, 1916. London : E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

Rotary Converters. Issued by the British Thomson-Houston Co., Ltd., Rugby.—We have often pointed out the educational value of the publications of manufacturing firms, including both catalogues and descriptive pamphlets under this head ; our attention has again been drawn to this subject by the receipt of a brochure on rotary converters from the B.T.H. Co., which is really a technical treatise, in short compass, of great interest and value, representing a considerable advance upon its predecessor. The principles upon which the converter depends, the conditions as regards heating in the armature winding, the behaviour of the machine when running, &c., are lucidly discussed, and, in addition, new matter has been inserted dealing fully with the very important question of variation in voltage ratio by reactance control, boosters, induction regulators, and the split-pole system. The starting of rotary converters by various methods, including the convenient self-synchronising system, is explained, and the details of construction of the makers' converters are described at some length, the whole being fully illustrated. The brochure is entitled "Descriptive List No. 2,420 A" ; but this is a misleading title, and does less than justice to the contents, which contain nothing in the nature of a catalogue or price list, but are purely technical, and will prove of the greatest value to engineers who use this type of plant.

We have received a list of new electrical books which have been added to the excellent library of electrical works issued by the Hill Publishing Co., including a comprehensive treatise on "Hydro-Electric Power," by Lamar Lyndon ; "Pole and Tower Lines," by R. D. Coombs, and a number of works which we have recently reviewed.

Messrs. Constable & Co. will shortly publish an authorised translation by Mr. J. H. Johnson of "The Range of Electric Searchlight Projectors," by M. Jean Rey, in order to meet the urgent demand for reliable information concerning the theory and practical application of searchlight projectors, their range and resultant illumination. The whole subject is exhaustively dealt with, and embodies records of the author's original investigations and tests, carried out in various parts of the world under actual working conditions.

Openings in Italy.—The following are selections from lists of openings for British articles in Italian markets. The lists are issued by the British Chamber of Commerce for Italy, Genoa :—

No. 1,159.—Agent at Taranto would sell on commission or buy for own account, electrical articles, ironmongery. T.P.P.
No. 1,163.—Spezia firm wishes to get into touch with manufacturer of electrical and engineering materials. S.U.C.
No. 1,164.—Merchants at Genoa wish to represent manufacturers and shippers of industrial and marine engineering articles.
No. 1,170.—Agents at Spezia would represent on commission manufacturers of engineering articles, machinery for industries, belting, wire ropes, &c. S.C.B.F.
No. 1,197.—Monza agent would represent manufacturers and shippers of engineering articles (leather belting, &c.). M.D.C.
No. 1,189.—Florence firm wishes to get in touch with manufacturer of electric lamps, machinery for same, and vacuum pumps. F.A.R.D.E.
No. 1,192.—Genoa importers wish to purchase grindstones, emery wheels, steel files, tools, machinery. G.A.P. & C.
No. 1,201.—Merchants at Genoa would handle machinery, electrical sundries, &c. G.G.H. & C.
No. 1,206.—Genoa merchants wish to be put in touch with manufacturer of engineering articles and supplies, lubricating oils and greases, cotton waste, leather belting, wire ropes, engine packings, machinery and tools (wood, iron and tinworking), &c. G.F.M. & C.

Commercial Electric Trucks.—THE BRITISH MINIATURE ELECTRIC VEHICLE CO., LTD., have started business at 10, Hoghton Street, Southport, for the manufacture of 500 lb. commercial trucks for use in warehouses and works, provided that orders are accompanied by a certificate from the Ministry of Munitions.

Bankruptcy Proceedings.—CHARLES HERMAN LIEBBRAND, described as an author, lately residing at Llangollen, Felixstowe, who was largely interested in a scheme for supplying electricity to Suffolk.—At the London Bankruptcy Court, on December 7th, before Mr. Registrar Brougham, this public examination was held. The debtor, who is confined in the Stratford Camp as an alien enemy, was brought to the Court by a military escort. He has lodged accounts showing liabilities of £1,080 and assets valued at £6,633, and consisting for the most part of various claims under agreements. In the course of his evidence the debtor stated that in or about January, 1913, he obtained an option for the purchase of the undertaking and assets of the Suffolk Electricity Supply Co., but owing to the outbreak of war he was unable to arrange the formation of a new company to take over the option. In fact, he attributed his failure to inability to carry through his various schemes in consequence of the war, and the collapse of promises from people upon whom he had relied to help him through.—The Official Receiver : But, surely, the option for purchase of the Suffolk electricity scheme expired some considerable time before war was declared ?—The debtor thought it was in June, or perhaps in September, 1913, that the option lapsed. He agreed that until the outbreak of war he was living at the rate of £1,000 per annum. He expended over £1,000 in connection with the electricity scheme, but was unable to give details of the expenditure beyond the items in his bank book. It was not his custom to keep books of accounts, and not being a trader he was not bound to do so. The examination was concluded.

THOMAS BROOKES, electrician at munition works, late picture house proprietor, Halesowen.—December 27th is the last day for the receipt of proofs for dividend. Trustee, A. M. Fairbairn, 1, Priory Street, Dudley.

CONNOLD, R. E., late electrician, now R.N.A.S., Canterbury.—Second and final dividend, 1s. 1d. in the £, payable December 30th, at the offices of Corfield & Cripwell, 119, Finsbury Pavement, E.C.

Trade Announcements.—MESSRS. BELCO, LTD., Windsor House, Kingsway, London, W.C., have issued a circular letter contradicting a statement which is in circulation to the effect that the company numbers among its shareholders certain persons of enemy origin, and has on its board German representatives. We are informed that all the shares once so held have been acquired by holders British by birth and extraction, and that the board of directors as now constituted is wholly British. Further,

the articles of association have been so altered that all aliens are debarred from obtaining any interest in the company, direct or indirect, now or at any future time, without the special authority of the Board of Trade.

Electric Supplies and Engineering, Ltd., is the name of a company formed to carry on the business of Haes & Eggers, Ltd., at 163, Clarence Street, Sydney, N.S.W.—*Tenders.*

Catalogues and Lists.—Bastian Electric Co., Ltd., 185, Wardour Street, London, W.—Fourteen-page abridged list in a warm attractive cover giving illustrated particulars relating to their electric heating apparatus. A special system of numbering is employed whereby the ordering of any particular voltage or type of glower is simplified. In the case of replacements, the customer merely compares with the catalogue number the voltage stamped on the terminals of the glowers in his heater. The A and B type heaters, also "Lantern," "Admiralty," "Pygmy," "Pyro-ring," and "Pyro-stove" appliances are included.

Igranic Electric Co., Ltd., 147, Queen Victoria Street, London, E.C.—Pamphlet No. 607 contains an illustrated description of their new push-button control system.

LIGHTING AND POWER NOTES.

Aberdeen.—Extensions.—The Corporation Electricity Committee has authorised Mr. Bell, the electrical engineer, to obtain tenders for the proposed extension of the power station buildings. The estimated cost is about £3,700.

Bath.—Price Increase.—The City Council has increased the price of electricity for lighting by ½d. per unit.

Batley.—The Tramways and Electricity Committee last week decided to recommend the appointment by the Corporation General Purposes Committee of a Street-Lighting Committee.

The engineer has been instructed to report, at the next meeting, on the value of the steam from the destructor used at the electricity works.

Birmingham.—The Electricity Supply Committee has been requested to furnish the Council with a summary of the advice given it by the officials of the department since November, 1911, as to the probable necessities for extending the generating plant, and its action thereon.—*Birmingham Evening Despatch.*

Blackpool.—The Town Council has passed a resolution in favour of extending the borough boundary, so as to include the Bispham U.D.C. and the latter's electricity undertaking.

Bradford.—Proposed New Power Station.—The Electricity Committee is considering the question of a new power station on the big estate at Esholt, six miles from the city, which is the property of the Corporation, and is largely occupied by the city's big sewage undertaking. The site in Valley Road offers little room for further extension, there being practically only space for one more 10,000-kw. machine. At Esholt there is almost limitless space and plenty of water. It is regarded as likely that the proposal will figure amongst local contemplated after-the-war works.

Colombia.—The Municipal Council of Remedios, Department of Antoquia, has been authorised to raise a loan of £5,360, to be devoted to electric lighting and water works in the district; the Municipal Council of San Jeronimo, to raise a loan of £800, for the installation of an electric power plant; and the Municipal Council of Quibdó, the capital of Choco Intendency, to raise a loan of £2,000, for electric lighting works.—*Board of Trade Journal.*

Continental.—Germany.—According to the German papers, the Federal Council will shortly issue an order prohibiting any sort of illuminated advertisement, also ordering all shops (with the exception of those selling drugs and food) to be closed at 7 p.m., and restaurants, cafés, theatres and kinemas at 10 p.m. The lighting of private houses is to be restricted as much as possible, and the tramway services are also to be reduced.

Darlington.—Hiring Charges.—The report of the electricity department shows an increase of 23 per cent. in the number of units sold for lighting and power during the period from April last as compared with the previous year. In regard to the charges for outside electric lamps used by shopkeepeers, the Committee has decided that the present annual charge of 14s. per lamp shall be suspended after the twelfth quarterly payment, provided the hirer signs an agreement to hire the lamp for a further three years. Where no agreemeut is entered into, the charge is to be 14s. per annum until the restrictions are removed or for a maximum period of six years from the date of the installation of the lamps.—*North-Eastern Gazette.*

Deal and Walmer.—The Board of Trade has extended the time under the Deal and Walmer Gas and Electricity Co. for laying mains by one year.

Derby.—Loans Sanctioned.—The T.C. has received sanction to loans of £5,000 for mains and £4,000 for motors.

Elland (Yorks.).—Street Lighting.—Efforts are being made to secure better street lighting. The streets are very largely lighted by electricity, and councillors find difficulty in seeing any objection to electric lighting, in view of the ease with which it can be extinguished at a moment's notice.

Farnham.—Price Increase.—The Gas and Electricity Co. has increased the price of electricity for lighting to 8d. per unit, and for purposes other than lighting to 4d. per unit, except for four hours per day, during which period the charge will be 8d. per unit.

India.—Electric Heating.—*Indian Engineering* states that the Simla Municipal Corporation has decided to offer special cheap rates for electricity used for heating and cooking purposes during the winter months—November to March. In hill stations in India the maximum demand on the power station in the summer is considerably higher than that in the winter, and if special concessions in the way of cheaper rates are given to the winter residents, it is hoped to bring the winter demand up to that of the summer. As the system is a hydro-electric one, with fixed charges for maintenance, &c., and no fuel charges, there are no financial difficulties. The demand for electric heating in Simla this winter is considerably in excess of what it was last year, and when the cheap rates are made public it is anticipated there will be a greatly increased demand.

It has been found that electricity at half an anna a unit compares very favourably in cost with coal and wood fires for general heating purposes and charcoal for cooking purposes.

London.—Hackney.—The Finance Committee has reported on the excess expenditure, beyond the original estimates, on the generating station extensions, and recommends that application be made to the L.C.C. for sanction to a loan of £10,833 to cover the additional expenditure. The original estimate was £140,650, which included work not yet carried out, and the total cost has been £144,516, while the loans sanctioned were for £134,050. The estimated cost of the buildings, £16,400, increased to £27,233, due to delay and increased price of materials, &c.

Malvern.—Stand-by Supply.—The Electricity Committee has had under consideration the question of the charge to be made where the supply of electricity is required only as a stand-by, and has recommended that a charge of 10 per cent. per annum be made on the last full year's consumption in respect of the premises; in cases where a full year's consumption is not available, a charge is to be made proportionate to the size of the plant, such charge to be exclusive of any charge for electricity supplied.

Oulton Broad.—The U.D.C. has consented to Lowestoft T.C. supplying electricity to the new works of Messrs. J. W. Brooke and Co., Lowestoft having made arrangements to supply energy.

Ripon.—E.L. Scheme.—The B. of T. has refused to vary its order not to allow the City Council to take further steps for obtaining a provisional order for the supply of electricity to Ripon and adjoining parishes. At a meeting of the Council, specially called last week, it was, however, decided again to approach the B. of T. with a view to its reconsideration of the question.

Rochdale.—The Gas and Electricity Committee has been instructed to report on the causes of the unsatisfactory conditions in relation to the supply of electricity, and its proposals for meeting immediate and future demands for supply.

Sheffield.—Prospective Extensions.—The Parliamentary Committee of the City Council has passed a resolution in favour of promoting a Bill in the present Session of Parliament to enable the Council to provide a new generating station, also to extend the city boundaries so as to include within the city the site proposed to be utilised and certain adjoining land. In accordance with instructions, the general manager has submitted to the Electric Supply Committee a statement of estimated income and expenditure on revenue account for the years ending March 25th, 1917, and 1918. He put the revenue for the former at £431,000 and for the latter at £525,250, while the expenditure for the year ended March, 1917, would be £228,527 and for 1918 £293,812, leaving gross profits of £202,473 and £232,438 respectively. Two extra-high-tension feeder cables are to be laid between Neepsend station and Carbrook sub-station, a distance of 5,920 yards, at an estimated cost of £23,770. Other extensions include the following:—To Effingham Steam Works and Rolling Co., estimated cost £567; to Sheffield Forge and Rolling Mills Co., estimated cost £547; to Spartan Steel Co., estimated cost £370; to Messrs. J. Bedford & Sons, estimated cost £237; to Messrs. W. Atkins & Co., estimated cost £125; to Messrs. W. Turner & Co., estimated cost £121.

St. Annes-on-the-Sea.—Year's Working.—The Urban Council's electricity works for the past year show an increased sale of 15,734 units, the decrease on public and private lighting being more than made up for by the increase in motive-power supply.

St. Helens.—Price Increase.—The charges for electricity for power purposes are to be increased by 20 per cent., instead of 10 per cent., as from January 1st, 1917.

Stockton-on-Tees.—Under the title of the Corporation Lighting Committee, a Committee has been appointed to take over the work until recently carried out by the Electricity Committee and the Gas Committee.

Torquay.—The Tramway Co. has offered to purchase the Corporation's electricity undertaking, but the Council has replied that it does not contemplate selling the undertaking.

Walsall.—Shortage of Plant.—The Electricity Supply Committee reports that the delay in getting the plant at the Birchills station into commission has increased the difficulty of maintaining the heavy winter loads with the plant at the Wolverhampton Street station, and during the past month several breakdowns have occurred. If necessary, the tramway supply will be shut down or curtailed, to enable the supply to factories to be maintained.

Wimbledon.—A special meeting of the Council is to consider the proposed application for a prov. order to supply energy in Cuddington, which has been favourably considered by the B. of T. The L.G.B. has sanctioned the borrowing of £727, excess expenditure, in connection with the Malden and Coombe supply.

Yeadon.—Prov. Order.—The Electrical Distribution of Yorkshire, Ltd., has notified its intention to apply for a prov. order for the supply of electricity in Yeadon.

TRAMWAY and RAILWAY NOTES.

Accrington.—Wages.—The Corporation has sanctioned the proposal of the Electricity and Tramways Committee to increase the wages of car drivers, conductors, and cleaners by ½d. per hour. The drivers, who are at present receiving 7½d. per hour, will only accept the advance as a war bonus, pending a settlement as to their claim for 8d. per hour.

Ashton-under-Lyne.—Tramway Purchase.—The T.C. has decided to promote a Bill in Parliament to take over the tramway system of the Oldham, Ashton, and Hyde Tramways Co. within the borough, which will link-up with the tramway systems of Oldham, thus providing for through running.

Australia.—Messrs. McCarty, Underwood & Co., consulting engineers, have submitted a report to the Richmond (Vic.) Council on the proposed electric tramway from Prahran, *viâ* Richmond, to Clifton Hill, a distance of 3·9 miles. The cost is estimated at £173,367, the proportional costs to the interested municipalities being: Collingwood, £65,934; Richmond, £65,820; Prahran, £41,623. A new bridge over the Yarra river to carry a double-track tramway has also been suggested.

An Order in Council has been granted by the Victorian Government for the construction of two miles of electric tramway traversing the municipalities of Fitzroy, Northcote, and Preston.

The Prahran and Malvern Tramway Trust (Vic.), which has hitherto had its cars manufactured in Adelaide, has now commenced construction on its own account. The side frames of the trucks will be of cast, instead of forged, steel.

Bolton.—Electric Vehicles.—The Electricity Committee has appointed a Sub-Committee to consider and report upon the question of purchasing an electrically-propelled vehicle for the use of the electricity department, and also, if thought desirable, to confer with the several Committees of the Corporation using horse or other vehicles as to the desirability of obtaining electrically-driven vehicles.

Wages.—The Tramways Committee has received a letter from the Lancashire District Council of the Amalgamated Association of Tramway Workers, giving 21 days' notice on behalf of members of the Association in the employ of the Corporation Tramways Department, to withdraw their labour unless their recent application for an advance of wages and better conditions of labour is agreed to by the Corporation. It was decided that the terms of the letter should be reported to the Board of Trade Committee on Production.

Bradford.—Wages.—The Tramways Committee is in negotiation with the workers in respect of an application for increased wages, which, if granted according to the men's requests, will cost about £21,000 per year. The men also ask for a revision of working conditions. It is understood that the Sub-Committee proposes to offer payment of time-and-a-half for the seventh day of work, in lieu of the men's request for time-and-a-half on Sunday—the Sub-Committee preferring not to specify Sunday as necessarily the seventh day. The Sub-Committee also offers to pay time-and-a-half for time worked beyond the normal day, which may be 11½ hours, in lieu of time-and-a-half for all above the 9½-hours' day asked for by the men. In regard to rates of pay, the Sub-Committee considered only the drivers and certain shed workers, who, it is believed, were offered an increase equivalent to half the savings which might be effected by them in the consumption of energy during the next six months. It should be mentioned, however, that similar proposals to these were, so far as can be gathered, rejected by the men a week previously. It is understood that the full Tramways Committee approved the Sub-Committee's action by a small majority.

Road Maintenance.—The Corporation Tramways Committee and the Finance and General Purposes Committee have, subject to final approval, come to terms in regard to the division of responsibility and cost for the laying, renewing, and repairing of the tramway permanent way. The staff and workmen employed and paid by the Tramways Committee, but at present under the control of the city engineer, are to be transferred to the control of the tramway manager. The foundations and paving work of roads over which the tramways run will be under the Street and Works Committee, an agreed sum per annum being paid by the Tramways Committee for this work, so far as it applies within the rails, and for 18 in. on each side. This sum would have regard to the present mileage, and be subject to reconsideration at the end of three years, and would cover all repairs and renewals, which have now become tolerably uniform year by year. In the construction of new lines, the cost of foundations and paving to be the subject of a special agreement between the two Committees, or fixed as before mentioned. All work in connection with the specifying, purchasing, and laying of metals, either for new work, renewals, or repairs, to be carried out by the Tramways Committee.

The Tramways Committee has passed a resolution recommending adequate lighting on tramway routes where electric street lighting is installed.

No cars are to be run on Christmas Day, as last year.

Burnley.—Service Curtailed.—The T.C. has decided that the last cars on the Padiham and Nelson routes shall leave the Town Centre not later than 10 p.m., and on other routes not later than 10.15 p.m. The change commences on Monday next.

Continental.—Spain.—A new company has just been formed at Aviles (Asturias) with a capital of £50,000 and the title La Compania del Tranvia Electrico de Villalegre à Castrillon, to construct and work an electric tramway between the towns named.

Darlington.—Fares.—At a meeting of the T.C. last week, the Electricity and Light Railway Committee recommended that the ½d. fares be suspended temporarily on Saturdays after 1 o'clock. Ald. Starmer, who moved the report, said that at present they were unable to deal with the traffic, and the fairest way was to give those who were going the longest distance the chance of a ride. The recommendation was agreed to.

Edinburgh.—Tramway Ferry.—Possibilities of tramway extension from the city to Queensferry in connection with the development of Rosyth have been discussed by the Tramway Committee of the Town Council. It is suggested that an electric system from the city could be extended to Queensferry, and linked with the Rosyth area and Fife towns by means of ferry boats, on which the cars could be taken across the Forth. The matter will be further considered.

Glasgow.—Half-year's Traffics.—The traffic returns for the T.C. tramways to the evening of December 2nd, which is two days more than the six months of the financial half-year, show that the total receipts during that period have been £623,046, as compared with £574,254 in the corresponding period of last year, an increase of £48,791. The number of passengers carried has been 193,800,839, as compared with 179,590,102, an increase of 14,210,737. Last week the receipts were £23,346, an increase of £2,349 as compared with the corresponding week of last year, while the number of passengers was 7,485,148, an increase of 711,061.

Keighley.—Electric Vehicle.—The T.C. has given sanction for the purchase of an electric vehicle for the removal of ashes. The cost, about £1,100, is to be met by the savings on the estimates last year and this.

Leeds.—New Route.—By the opening of a new tramway route, the residents of the thickly-populated district of Stoney Rock will be enabled to get right to the centre of the district, instead of to the fringe. The route was opened on Tuesday, the 5th inst.

Liverpool.—Mr. Mallins, the general manager of the Corporation tramways, is experimenting with an apparatus for solving the question of calling out stations. The device, which is a gramophone arrangement connected with an electromagnetic route indicator, will announce the names of stations automatically, and it has been attached to one of the cars for experimental purposes, a demonstration being given last week-end.

Newcastle-on-Tyne.—Extensions.—At a meeting of the City Council on the 6th inst., a recommendation of the Tramways Committee was adopted that, in order to deal adequately with the traffic in Union Road and Miller's Lane at the east end of the city, a junction be constructed between the lines in the two roads named, and the rails leading out of the south end of the sheds in Miller's Lane be joined up with the rails in Shields Road. The total cost, including land, is estimated at £6,000.

The City Council has approved (December 6th) of a recommendation by the Tramways Committee that land two acres in extent near the Scotswood Suspension Bridge be purchased for tramway purposes for £3,500.

Beginning last Monday, the last cars on all routes leave the city at 10 p.m.

Rochdale.—The Tramways Committee has reported against the application of the Rawtenstall electrical engineer that, in view of the greatly increased cost of coal, it should consent to an increase of 10 per cent. on the price of energy supplied for tramway purposes on part of the Bacup section.

The Committee has declined the request of the men's Union that there should be a cessation of the service on Christmas Day, but with the usual payment. Applications for increased wages are to be referred to the Committee on Production.

Scarborough.—DIVIDEND.—At the annual meeting of the Scarborough Central Tramway Co., last week, pleased surprise was expressed that, under the considerable difficulties which it had had to face, it was enabled to pay a dividend of 1s. 6d. per share.

Sheffield.—Employés in the tramway and motor department are to receive additional allowances estimated to cost £15,120 a year, making the total estimated cost of war allowances granted £30,610 per annum. The total estimated receipts from the tramways for the year ended March 25th, 1917, are £509,857, and for the year, ending March, 1918, £523,683. The total estimated expenditure for the two years is £473,632 and £505,938.

Southport.—YEAR'S WORKING.—The annual report of the manager of the Corporation tramways shows that the traffic receipts created a record for the undertaking, being £20,005, the total revenue being £400 more, and practically the same as last year. Considering the war, and that 12,244 car-miles less were run, Mr. Kendrew considers the results very good indeed.

Swansea.—The electrical engineer reports that the whole of the energy for the Tramways Co. is now supplied from the Corporation generating station.

The list of work to be undertaken after the war includes tramway extensions estimated to cost £54,000.

Wolverhampton.—The Tramway Committee proposed to pay £15 royalty to the manager for each car fitted with the "Silvers' Dynamic Pickup," provided the T.C. had the option of fitting any number of cars for £750, less royalties already paid. The recommendation was referred back by the T.C.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Postal authorities have decided to introduce into Australia, on trial for 12 months, at the central exchanges in the capital cities, a system whereby if any telephone subscriber is out of call, the telephone operator will take a message and telephone it to the subscriber as soon as he may be available.—*Melbourne Age.*

Greece.—It is announced that wireless communication has been re-established between Athens and Constantinople.

Italy.—Italian steamers and sailing vessels having more than 50 persons on board (including the crew) are now required to carry wireless telegraph apparatus.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—January 22nd. Electrical plant (converter, battery, booster, and switchboards) for the Castlereagh Street sub-station, for the Municipal Council. Specification from E.L. Department, Town Hall.*

February 19th. Municipal Council. Meters, maximum demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

QUEENSLAND.—December 12th. P.M.G.'s Department. Caps and lamps for switchboard, covered wire, benders, sleeves, and tapes. See "Official Notices" December 1st.

January 1st. P.M.G.'s Department. Cords, switchboard, parts and accessories, measuring instruments and telegraph instruments. See "Official Notices" December 1st.

PERTH.—January 10th. P.M.G.'s Department. Telephone instruments and parts. See "Official Notices" to-day.

Aylesbury.—December 16th. U.D.C. Electricity Department. Paraffin oil for one year (800 gallons); Diesel lubricating oil for one year (500 gallons). See "Official Notices" December 8th.

Bridgend.—December 15th. Hospital Committee. Electrical wiring at the Isolation Hospital, Cefn Hirgoed. Mr. D. R. Jones, Clerk, 10, Wyndham Street.

Cape Town.—January 5th. Electric motors and starting panels, for the Corporation Electricity Department. Dock Road, Cape Town.*

Durban.—January 3rd. Corporation. One 3,000-KW. steam turbine, alternator, and condensing plant. Specification No. S 238 and drawing No. P 597, both at the office of the Borough Electrical Engineer, Municipal Buildings. Deposit £2 2s.

Johannesburg.—December 20th. Corporation. Automatic pressure regulators for the A.C. turbo-generators at the power station.*

January 3rd. Corporation. Iron axles and bushes.*

London.—ENFIELD.—Electric light installation, Ponder's End Congregational Church. Rev. J. H. Bennett, pastor.

December 16th. H.M. Office of Works. Materials for electric bell wiring. See "Official Notices" December 8th.

L.C.C.—December 19th. 325 tons of rolled-steel bars for magnetic brake shoes. Chief Officer, L.C.C. Tramways, 62, Finsbury Pavement.

New Zealand.—DUNEDIN.—January 24th. Motor-generator, accessories and spares. City Electrical Engineer, Market Street, Dunedin.*

TAURANGA.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. Messrs. H. W. Clime and Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

Sleaford.—December 22nd. Best hard steam coal (about 250 tons), for the U.D.C. electricity works. Mr. G. Horry, Electrical Engineer.

Spain.—The municipal authorities of Santisteban del Puerto (Province of Jaen) have just invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Accrington.—The Corporation has accepted the tender of Messrs. W. T. Glover & Co. for 220 yards of 7/20 S.W.G. cable.

Ardsley.—The U.D.C. has accepted the terms of the electrical supply company for putting down electrical plant at the Brodilley sewage works.

Australia.—The following contracts have been placed :—

Commonwealth Railways :—

1,200 yards 19/12 S.W.G. stranded copper cables, £180.—B.I. & Helsby Cables, Ltd.

One 25-KW. generating set for Darwin Jetty, £973.—A. H. McDonald & Co.

Victorian Railways Department :—

Electrically-operated hoist for Jolimont car-shed, £310.—Noyes Bros. (Melbourne) Pty., Ltd.

P.M.G.'s Department, W. Australia :—

Automatic telephone material, £108.—Automatic Telephones (Australasia), Ltd.

1,949 ft. paper-insulated, lead-covered telephone cable, 600 pairs, £580.—J. R. W. Gardam.

7,915 ft. paper-insulated, lead-covered telephone cable, 800 pairs, £4,362; 672 ft. ditto, 400 pairs, £240; 2,470 ft. ditto, 300 pairs, £664; 1,233 ft. ditto, 200 pairs, £227; 3,200 ft. ditto, 150 pairs, £391; 600 ft. ditto, 100 pairs, £57; 1,320 ft. ditto, 35 pairs, £56; 2,640 ft. ditto, 25 pairs, £90; 22 sounders, Morse American pony pattern, £21.—B.I. & Helsby Cables, Ltd.

2,000 dry cells, rectangular, £358.—Diamond Engineering & Trading Pty., Ltd.

3 miles of copper distributing wire, £102.—W. T. Henley's Telegraph Works Co., Ltd.

N.S.W. Public Works Department :—

Sixteen D.C. motors and equipment, £2,688.—Harvey & Phillips, for Brush Electrical Co. —*Tenders.*

Bath.—Messrs. Chamberlain & Hookham, Ltd., have received the Corporation contract for electricity meters for the coming year.

Bradford.—Tramways Committee :—

Hadfields, Ltd.—12 sets of manganese-steel points, £588.

Electricity Committee (subject to certificates of the Ministry of Munitions being obtained) :—

Brush Electrical Engineering Co., Ltd.—One 50-K.V.A. and two 300-K.V.A. transformers.

Ferranti, Ltd.—One 50-K.V.A. and two 300-K.V.A. transformers.

Bury.—The Corporation has entered into an agreement with the Electrical Power Storage Co., Ltd., for the maintenance of the storage battery at the electricity works for a further period of five years.

Canada.—The Toronto Hydro-Electric System has awarded to Eugene F. Phillips Electrical Works, Ltd., Montreal, a contract covering approximately eight miles of 250,000 circular mils, three-conductor, paper-insulated and plain lead-covered cable for a working pressure of 13,200 volts, at a cost of approximately $100,000, this being the fourth large order that it has placed with the Phillips Co. in the last two years for extra-high-tension cables.

Glasgow.—The Tramways Committee recommends the acceptance of the following :—

Scrap copper.—P. & W. MacLellan, Ltd.

Scrap armature coils, brass, brass turnings and borings, brass dust, copper and mica turnings, rubber cables, dry cells.—R. M. Easdale & Co.

Scrap lead, lead-covered cables.—Trainer & Allison.

Scrap rubber.—Pegler Bros.

Rubber-insulated cables.—W. T. Henley's Co.

Newport (Mon.).—T.C. Accepted tenders :—

British Westinghouse Electric & Mfg. Co., Ltd.—Converting plant, £1,480.

British Thomson-Houston Co., Ltd.—Low-tension B.C. switchgear £152 and extra-high-tension switchgear, £127 8s

Sheffield.—City Council. Accepted tenders :—

A. Reyrolle & Co., Ltd.—Twelve 100-ampere, E.H.T., oil-break furnace switches, £520.

R. White & Sons.—Taking up and relaying train-road track, £487.

A. Reyrolle & Co., Ltd.—30 panels of three-phase, E.H.T. sub-station switchgear, £5,156.

Brush Electrical Engineering Co., Ltd.—25 double-decked, top-covered tramcars without electrical equipment, £1,060 per car, plus 5 per cent. for contingencies.

Walsall.—T.C. British Thomson-Houston Co., Ltd., E.H.T. switchgear, £315.

Wolverhampton.—Electricity Committee. Accepted tenders :—

British Thomson-Houston Co.—Steam-turbine-driven boiler feed pump, £421.

Ransomes, Sims & Jefferies.—2½-ton "Orwell" electric lorry, £630.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, December 15th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, Westminster, S.W. Paper on "Variable-speed Gears for Motor Road Vehicles," by Mr. R. E. Phillips.

Illuminating Engineering Society.—Friday, December 15th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. "Suggestions regarding War Economies in Lighting," by Mr. L. Gaster.

Electro-Harmonic Society.—Friday, December 15th. At 8 p.m. At Holborn Restaurant (King's Hall). Smoking concert.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, December 16th. At 4.30 p.m. At the Royal Technical College, Glasgow. Social evening.

(Midland Branch).—Saturday, December 16th. At 3.30 p.m. At the Midland Hotel, Mansfield. Discussion on the Report on "Electric Signalling with Bare Wires."

Faraday Society.—Monday, December 18th. At 8 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Ordinary meeting.

Institution of Civil Engineers.—Tuesday, December 19th. At 5.30 p.m. At Great George Street, Westminster, S.W. Paper on "Experiments on Earth-Pressures," by Mr. P. M. Crosthwaite.

Royal Society of Arts.—Wednesday, December 20th. At 4 p.m. Paper on "Classical and Scientific Education," by Mr. A. C. Benson, Master of Magdalen College, Cambridge.

Chemical Society.—Thursday, December 21st. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Greenock Electrical Society.—Thursday, December 21st. At 7.45 p.m. At 22, West Stewart Street. Reading of papers submitted by junior members.

Belfast Association of Engineers.—Thursday, December 21st. At 7.45 p.m. At Municipal Technical Institute, College Square. Paper on "Water Power in Ireland," by Mr. A. W. Brown.

NOTES.

U.S.A. Central Station Output.—In August last, says the *Electrical World*, the output of U.S. electricity supply stations was larger than in any previous month on record, being 1,880,000,000 KW.-hours—300 millions in excess of that of August, 1915. The income was well over six millions sterling.

Foreign Trade.—THE NOVEMBER FIGURES.—The official returns of imports and exports during last month contain the following electrical and machinery figures :—

	Nov., 1916.	*Inc. or dec.*	*Eleven months*, 1916 *Inc. or dec.*
IMPORTS :—			
Electrical goods, &c.	£133,648	+ £2,314	+ £475,776
Machinery	628,266	− 124,398	− 675,170
EXPORTS :—			
Electrical goods, &c.	309,769	− 96,141	+ 947,420
Machinery	1,889,431	+ 286,868	+ 854,448

Christmas Fire Risks.—The British Fire Prevention Committee has issued a free "Warning" regarding the dangers incidental to Christmas entertainments, due to the use of inflammable materials for decorations, &c. Copies may be obtained from the Committee (8, Waterloo Place, Pall Mall, S.W.), on written application, with the necessary return postage enclosed.

Sentence.—On December 7th, at the Central Criminal Court, Thomas Absalom Jackson was sentenced to three years' penal servitude on a charge of having demanded money with menaces from Marconi's Wireless Telegraph Co., Ltd., and Mr. Godfrey Isaacs, and with offering to prevent the publication of certain matters (in the *Financial News*) with intent to extort money.

Fatalities.—On November 25th, as the result of a "practical joke," G. L. March, aged 22, was killed at a workman's cabin on the L. & N.W. Railway, near Loudoun Road Station, South Hampstead. At the inquest it was stated that someone had fixed an electric wire to the door-handle; the deceased was going to enter the hut, received an electric shock, and died almost at once. He was found, on post-mortem examination, to have heart disease and tuberculosis, so that a slight shock would suffice to kill him. Percy Brown, aged 15, confessed to having connected the door-handle to the lighting circuit. Such pranks are worse than foolish, and should be severely punished.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters, Chester House, Eccleston Place.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, December 18th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8. Lecture, "On Telephones," 7.30.

Tuesday, December 19th.—School of Arms, 6—7. Lecture, 7.15, "Bridging," Company Commander E. J. Castell.

Wednesday, December 20th.—Instructional Class, 6.15. Platoon Drill, Platoon Nos. 1-2.

Thursday, December 21st, to *Thursday, December 28th*, inclusive.—Headquarters closed.

(By order) MACLEOD YEARSLEY, *Adjutant*.

Absenteeism at Electricity Works.—The case of a man employed at Neepsend generating station of the Sheffield Corporation electricity department, who had been summoned for being absent from work without leave, was mentioned in the Sheffield Police Court by the Deputy Town Clerk. The man, he said, had paid the money into Court, and therefore nothing more could be said in that case. But he was instructed to put before the Bench certain unpleasant facts concerning absenteeism at the generating station. There was now more time lost by workmen than ever before, and the man whose case had been mentioned, although he had only been summoned on account of one day, had been absent on other occasions. He asked the Bench to give public expression in reference to what was a serious state of affairs.

Mr. J. C. Clegg said that absenteeism was a matter of regret and serious consideration by all in authority. It was undoubtedly of the highest importance that regular attendance at work must be ensured. It was the duty of those responsible to take such steps as would bring about an improvement in the matter, and he hoped this public reference to the matter would make the men realise to the fullest extent what their responsibilities were.—*Sheffield Telegraph*.

Manchester and District Decimal Association.—At the debate on the decimal system at the Engineers' Club on the evening of Tuesday, last week, the Lord Mayor of Manchester (the first president of the Manchester and District Decimal Association) was in the chair, and the debate was very effectively opened by Mr. E. C. Barton, M.I.E.E. An animated discussion ensued, and Mr. Barton replied briefly to the principal points raised in the course of the debate. At the close of the meeting a practically unanimous vote (there being only two dissentients in a large meeting), was given in favour of :—

(*a*) The early adoption of a decimal system of British coinage.

(*b*) The compulsory use, after a suitable transition period, of the metric system of weights and measures throughout the British Empire.

Police Flash Lamps.—A Huddersfield police constable, Albert J. Cashmore, has invented an electric signalling flash lamp for constables on point duty, and the Watch Committee last week decided to give the lamp a trial. The apparatus has two lights, one red and the other green. The red bulb is attached to the inside of one hand and the green bulb to the outside of the other hand, both being connected with an accumulator on the constable's belt. The lights do not show until the constable raises his arms. The inventor claims that this will be a great boon in the darkened streets, in which the point policemen can scarcely be seen.

America's Electrical Week.—Whilst we grope in darkness that may almost be felt, our friends in the United States have just been celebrating their great "Electrical Week" with a perfect orgy of electric lighting. The "Week" opened on December 2nd, and ended last Saturday; the principal event, by way of inauguration, was a reception to President Wilson, who witnessed the turning-on of the permanent "flood-lighting" illumination of the statue of Liberty, and took part in a parade of electric vehicles. The route was brilliantly illuminated and decorated, and was expected to "present an illumination spectacle unparalleled in the annals of lighting in America." Elaborate arrangements were also made for the celebration of the "Week" in all the principal cities of the States.

British Trade Bank.—Information will be eagerly awaited as to the action to be taken by the new Government in regard to the British Trade Bank scheme advocated by Lord Faringdon's Committee. The Central Executive of the Employers' Parliamentary Committee last week passed a resolution urging the Government to take immediate steps to establish such a bank, and expressing the opinion that the proposed capital, £10,000,000, would be quite inadequate.

Educational Notes.—The Bradford Technical Education Sub-Committee has resolved that the arrangement made last session for assisting the Leeds University in the matter of tuition in electrical engineering be again authorised for the present session.

THE RUSSIAN LANGUAGE.—The *Daily Chronicle* states that Captain H. Samman, a shipper, has given £10,000 to found scholarships for teaching Russian to Hull students, his object being to encourage commercial and other relations between Hull and Russia. The Hull Chamber of Commerce is to formulate the scheme. The excellent idea of establishing travelling scholarships, such as we have already referred to in respect of the textile, electrical, and engineering trades is also likely to be adopted.

Appointments Vacant.—Shift engineer (£104) for the Watford U.D.C. Electricity Works; two shift engineers (40s. to 50s.) for the Chesham Electric Light & Power Co; electrical engineer (clerk of works) for the Royal Engineers' Office at Ashford, Kent (63s.) See our advertisement pages to-day.

Conference of Electrical Engineers in India.—The Public Works Department, Government of Bengal, announces that the annual Conference of Electrical Inspectors will be held in December this year, in Calcutta, at the Indian Museum. Representatives of the Bengal Chamber of Commerce, the Indian Mining Association, and the Calcutta Trades Association have been invited to attend.—*Indian Engineering.*

Tramcar Passenger Fined.—At Doncaster Police Court, on Tuesday, John Wilkinson, a filler employed at a colliery, was summoned for interfering with the electrical equipment of a tramcar. It was said that on the night of November 26th defendant was standing on the footboard of a crowded tramcar, and whilst the conductor was inside taking fares, the defendant noticed a woman running after the car, and deliberately pulled out the main controller switch, which cut off the current and stopped the car. Mr. Allen, prosecuting, said that this was a most dangerous thing to do. In defence, the defendant said the car jerked, and he put his hand up and accidentally knocked out the switch. He was fined 15s.

Copper "Permits."—The Minister of Munitions has issued the following order:—

1. No person shall as from the date hereof buy, sell, or, except for the purpose of carrying out a contract in writing existing prior to such date, enter into any transaction or negotiation in relation to the sale or purchase of copper of any class, whether wrought or unwrought, situated outside the United Kingdom unless such person is authorised by a Special Permit from the Minister of Munitions to purchase or sell the same.

All applications for Special Permits shall be made to the Director of Materials, Armament Buildings, Whitehall Place, London, S.W., and marked "Copper Permit," and all persons to whom such permits are granted shall observe and perform all the conditions subject to which such permits may be granted.

2. All persons shall, except as below mentioned, not later than the 16th day of December, 1916, send in to the Director of Materials, Armament Buildings, Whitehall Place, London, S.W., returns of:—

(*a*) All unwrought copper at the date hereof held by them in stock or otherwise under their control.

(*b*) All unwrought copper due at the date hereof for future delivery to them.

(*c*) All contracts existing at the date hereof for the sale to or purchase by them of unwrought copper.

Notwithstanding the above, no return is required from (1) any manufacturer or smelter of stock in hand or due for future delivery for the sole purpose of manufacture or smelting at his works; (2) any person whose total stock in hand and due for future delivery does not exceed 2 tons.

The Minister of Munitions has prohibited as from December 8th the use of copper, whether wrought or unwrought, in any kind of manufacture except for the purposes of a contract or order for the time being in existence, certified to be within Classes "A" and "B" of Circular L33 as to control of output dated March 31st, 1916. The order of November 6th relating to the manufacture of copper wire and cable containing copper is hereby cancelled.

Institution and Lecture Notes.—The Institution of Electrical Engineers.—On November 8th, the Chairman of the Yorkshire Local Section, Mr. H. A. Nevill, read his inaugural address, dealing with the supply and use of coal. Referring to the shortage of labour, which he expected to continue after the war, he stated that whereas the average loss of time for the whole of the United Kingdom was 9·9 per cent., in Yorkshire it was 15 to 20 per cent. The use of machinery was increasing at the rate of 10 per cent. per annum, mainly in Scotland, where the seams were thinner; the over-all efficiency of electrically-operated machines was as high as 70 per cent., compared with 20 to 25 per cent. for compressed-air machines, and therefore retarded the adoption of machinery owing to the low efficiency and small power available. Given a sufficiently high selling price or a cheaper system of working, more coal would be produced, even to the working of seams only two or three inches in thickness. He thought that modified regulations and more rapid development in the use of electrically-operated machinery below ground would tend to solve to some extent the present and future difficulty in the sufficient production of fuel. It did not seem likely that the cost of coal would come down to pre-war prices, and therefore station engineers would have to resort to more efficient plant, co-operation, or more economical methods of coal consumption than direct combustion. Linking-up would aid, where it could be adopted, but at first sight the saving did not seem sufficient to warrant the very heavy expenditure that would be necessary to carry it out. It would increase reliability of supply, and thus hasten the scrapping of isolated power plants in favour of public supply. The centralisation of power generation under skilled control would lead to economy, but he did not approve of very large stations. Waste heat and coke-oven gas should be utilised. Where towns were too far apart for linking-up, carbonisation plant with by-product recovery apparatus should be installed. As the economy schemes would involve heavy expenditure, the Government should make some provision for granting money on easy terms to electricity supply authorities; this could be done by way of a small tax on exported coal.

A fund is being raised to purchase the very valuable scientific library of the late Dr. Thompson, and to present it to the Institution of Electrical Engineers as a memorial of his life and work, the library to be accessible to the public on the same conditions as the Ronalds library. Information regarding it can be obtained from Mr. W. M. Mordey, 82, Victoria Street, London, S.W.

The I.E.E. *Journal* for December announces the election of Prof. G. Carey Foster, F.R.S., to be an Honorary Member, and the election of Sir W. Slingo as a member of Council, to fill the vacancy caused by the resignation of Captain R. J. Wallis-Jones.

At the monthly meeting of the Scottish Local Section in Glasgow, on Tuesday evening last, Mr. John S. Peck's paper on "The Parallel Operation of Electric Power Stations" was read and discussed.

The second meeting of the session of the Western Local Section was held on Monday last at the Institute of the South Wales Mechanical Engineers, Cardiff. Dr. Alex. Russell delivered the Kelvin lecture on "The Life and Work of Lord Kelvin," punctuating the same with numerous blackboard diagrams. The lecturer's propounding of Thomson's formulæ in connection with "Vortex Motion" was followed very closely, and would have been productive of discussion had this been in order. Principal Griffiths (University of Cardiff) in seconding the vote of thanks to Dr. Russell for his able lecture, alluded to some very interesting personal reminiscences which he could recall in connection with Sir William Thomson's visit to him at Cambridge. The anecdotes forcibly illustrated Lord Kelvin's kindness of heart and sympathy towards his fellow scientists.

Tramways and Light Railways Association and the Incorporated Association of Electric Power Companies.—The Government having taken over the greater part of Caxton House, these Associations have removed their offices to Sanctuary House, 33, Tothill Street, Westminster (facing Caxton House).

Wages of Electricity Supply Employes.—Marylebone Borough Council is calling a conference of local authorities to discuss the conditions of labour and rates of wages paid to employés in electricity supply undertakings.—*Pall Mall Gazette.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. W. G. Pickvance, borough electrical engineer of Wrexham, was injured in a motor-car collision on Monday last week. Both cars were damaged and all the occupants more or less injured.

The Newport Council has granted the following increases of salary upon the recommendation of the borough electrical engineer:—Mr. A. H. Felton, works superintendent, £166 to £175; Mr. W. H. Clarke, installations assistant, £140 to £150; Mr. E. G. Illingworth, sub-stations engineer, £130 to £140; Mr. F. B. Briggs, senior engineer-in-charge, £123 10s. to £135; Mr. W. A. Borrowdale, senior engineer-in-charge, £123 10s. to £135.

Mr. A. W. Clegg, acting manager of Accrington electricity works, was one of four candidates selected for the post of electrical engineer to a Cheshire chemical firm. As the result of an interview, on Monday, between the Electricity Committee and Mr. Clegg, arrangements were made whereby Mr. Clegg's services will be retained by the Corporation.

General.—Ald. Duncan Watson has been re-elected Chairman of the St. Marylebone B.C. Electricity Committee. He has accepted the position with reluctance, agreeing to act until the new and enlarged Committee has gained experience of the working of the undertaking.

Colonel A. Sinclair has been re-elected Chairman, and Ald. G. Colwill Vice-Chairman, of the Swansea Lighting and Tramways Committee.

The marriage took place, by licence, at Canterbury, on December 7th, of Mr. Frank Wilfrid Jordan, B.Sc., A.R.C.S. (Electrical Engineers), and Miss Fanny Bentley, only daughter of the late Mr. J. G. Wood, of Chartham (Kent).

By public advertisement it is announced that Mark Albert Nathan, carrying on business as an electrical and scientific instrument manufacturer as Albert Mason, at Clarence Mews, Hackney, London, has abandoned the name of Nathan, and will henceforth be known as Mark Albert Mason.

Sir Albert H. Stanley, the new President of the Board of Trade, is managing director of the Underground Electric Railways Co. of London, Ltd., also of the District, the London Electric, the Central London, and City & South London Railways, as well as being a director of the London United Tramways, Ltd., and the London & Suburban Traction Co., Ltd. His unique experience of the problems of transportation will be of great value to the nation at the present juncture. An article on Sir Albert, together with a photograph, appeared in the Electrical Review for June 26th, 1914, on the occasion of the honour of knighthood being conferred upon him.

Roll of Honour.—The current issue of the *Journal* of the Institution of Electrical Engineers contains a list of 27 more in the different classes of membership who have made the great sacrifice for their country. A further list of military honours awarded includes the following:—

D.S.O.—Bt. Major B. C. Battye, R.E.; Major R. A. McClymont, R.F.A.; Major A. Robertson, R.E.; Captain H. C. Sparks, M.C., London Regiment.

Military Cross.—Sec.-Lieut. W. H. C. Coates, R.F.A.; Lieut. R. H. Covernton, South African Engineers; Capt. J. M. Donaldson, K.R.R.C.; Sec.-Lieut. R. E. Keelan, R.E.; Sec.-Lieut. F. A. Menzies, Indian Infantry; Capt. S. M. Mohr, Notts. and Derby Regiment; Sec.-Lieut. B. J. Moore, Royal Flying Corps; Capt. E. H. E. Woodward, Gloucestershire Regiment.

Bar to Military Cross.—Capt. H. R. L. Groom, M.C., Royal Warwickshire Regiment.

Distinguished Service Cross.—Lieut. T. N. Riley, Divisional Engineers, R.N.D.

Distinguished Conduct Medal.—Sergt.-Major H. M. Kirkby, London Regiment.

Croix de Guerre (avec Palme).—Capt. H. C. Sparks, D.S.O., M.C., London Regiment.

Seventeen others have been mentioned in dispatches.

Lance-Corporal H. Mayes, Oxford and Bucks Light Infantry, who was with the British Thomson-Houston Co., Ltd., has for the second time been wounded in action.

Lance-Corporal H. Jarvis, Grenadier Guards, who has fallen in action, was for 12 years engaged at Silvertown with the India-rubber, Gutta-percha & Telegraph Works Co., Ltd.

Sapper F. Harold Moore, R.E., who was with the Marconi Telegraph Co., has died in a military hospital at Bristol.

Private James Watson, South African Infantry, aged 43, reported missing in France, was with the Transvaal Electric Power Co. in Germiston for 14 years, and his post was being kept open. It is stated that when last seen he was carrying a wounded man to the dressing station.

Battery Sergeant-Major C. F. Hunter, R.F.A., an employé of the India-rubber Co., Silvertown, has been awarded the D.C.M. for gallantry in France. A fire had been started by the enemy's shells in a gun-pit containing about 500 rounds of ammunition, the charges of some of which were burning, and with great presence of mind and risk to himself. Sergeant-Major Hunter extinguished the fire.

Sergeant G. W. H. Beckett, R.F.A., also an employé of the India-rubber Co., Silvertown, has been awarded the Military Medal for repairing telephone wires under fire, and for continued good work in connection with keeping up communications. He had previously been mentioned in dispatches. Sergeant Beckett was a reservist, and went to France with the original Expeditionary Force.

The following employés of the Edison Swan Electric Co., Ltd., have been killed in action, all in France:—

Private Ernest A. Fassum, 4th Batt. Middlesex Regiment, joinery shop.
Private John Edward March, 13th Batt. Middlesex Regiment, joinery shop.
Private Bert Pennington, Machine Gun Corps, brass shop.
Private Albert Cooper, 1st Batt. Gloucestershire Regiment, brass shop.
Lance-Corporal Harry Finch, 1st Batt. Middlesex Regiment, lamp department, stoker.

CITY NOTES.

Ferranti Ltd. The profit on trading for the year ended June, 1916, was £54,377, and after crediting transfer fees, and deducting general establishment charges, repairs and renewals, legal expenses, income-tax, bad debts, directors' and trustees' fees, there remains £21,563, plus £1,028 the amount at credit at June 30th, 1915. From the total, £22,591, there have been deducted:—Interest on first mortgage debenture stock £4,281, interest on five-year notes £2,076, interest on bank loans £1,660, depreciation reserve account £10,000, leaving to be carried forward £4,574. The results for the year show a satisfactory improvement both in output and profit, notwithstanding the increase in cost of materials, labour, freights, and other expenses. Arrangements are being made to increase the output of the works. During the year £2,800 first mortgage debentures and £800 five-year notes have been redeemed, and loans against five-year notes and second mortgage debentures have been further reduced. Mr. O. Winder has been elected a director. Annual meeting: December 19th, in London.

United Electric Car Co., Ltd. We read in a Birmingham newspaper that Messrs. Dick, Kerr & Co., Ltd., have circularised the shareholders in the United Electric Car Co., Ltd., offering to acquire the preference and ordinary shares of the latter company, by transferring one 6 per cent. cumulative preference share of £1 each, fully paid in D.K. & Co., in exchange for each preference share in the U.E.C. Co., the preference shares in D.K. and Co. given in exchange to rank for the full six months' dividend payable April, 1917, or in the alternative they will pay 20s. cash. As regards ordinary shares, the price will be 15s. in cash for each ordinary share. A meeting is to be called to deal with the position, and it is agreed to pay £3,000 to the directors retiring, as compensation for loss of office; this payment will not be made out of the assets of the U.E.C. Co. The U.E.C. Co. has also issued a circular stating that the terms are fair, and recommending shareholders who wish to dispose of their shares to accept the offer.

India-rubber, Gutta-percha, and Telegraph Works Co., Ltd. For the year ended September 30th, 1916, the net profit, after providing for doubtful debts, was £133,779. After adding £18,938 brought forward, deducting £12,5000 the dividend on the preference shares, and £12,500 the interim dividend on the ordinary shares paid in July, there remains a disposable balance of £127,716. The directors have restored to the reserve fund the £50,000 which was taken from it to meet the losses sustained by Persan and the foreign branches, and recommend that the half-yearly dividend of 5s. per share, or at the rate of 5 per cent. per annum, be paid to the preference shareholders, and that a dividend of 15s. per share, free of income-tax, amounting to £37,500, making with the interim dividend a total of 10 per cent. for the year, be paid on the ordinary shares, leaving £40,216 to be carried forward. No satisfactory estimate can be given as to the war taxation which the company will have to pay in respect of the profits made during the year, but the position is amply safeguarded. The debentures became due for repayment in March last, and under the existing state of the money market they could only be replaced at £93, and at 5 per cent. instead of 4 per cent. interest. This entailed an expenditure in cash of £28,000, and an extra liability in interest of £4,000 for 10 years. The directors took the opportunity of the great demand for tonnage to sell the cable ship *Silvertown*, which had little prospect of cable work during the war. The *Dacia*, after an absence of more than four months abroad, has been sunk by a torpedo, but all hands have been saved. She was fully covered by insurance. Col. Weston Jarvis has been serving with H.M. Forces in Gallipoli and Egypt since April, 1915, and is now home. Mr. Hanbury joined the Army, and is with his regiment in France.

[The net profit for the previous year was £80,404, and the disposable balance £56,438.]

Annual meeting: December 20th.

Costa Rica Electric Light and Traction Co., Ltd. For the year ending June, 1916, the net earnings in Costa Rica, after charging all expenses incurred, amount to £19,211, as compared with £21,662 for the previous year, a decrease of £2,451. The net surplus profit is £2,790; this is to be carried to the credit of discount and commission on debenture issue account. The power plant at El Brazil has worked well throughout the year. In common with other countries, Costa Rica is suffering severely from the European war, and the business of this company has continued to be prejudicially affected by the interruption of exports and the general upset of trade relations. Not only has its income been curtailed by the lower purchasing power of the people, but the cost of all stores and material has greatly increased by reason of war prices and the high exchange. Everything used in the business has to be imported and paid for in gold, while the earnings are in a temporarily depreciated national currency. The general manager in Costa Rica, Mr. W. N. Brand, was compelled to resign his position in July last through ill-health. The chief engineer, Mr. T. E. Zink, has been appointed to succeed him. Mr. Zink has been in the company's employ almost from its inception. During the year the gold premium has averaged 140 per cent., as against 150 per cent. for the previous year.

Victoria Falls & Transvaal Power Co., Ltd.—Dividend for the year on the preference sharas at the rate of 6 per cent. per annum, less income-tax, thereby making the cumulative dividend paid up to December, 1916.

Manx Electric Railway Co.—Gross receipts for year ended September, 1916, £8,150; expenditure, £8,865; loss, £734. Adding £9,436 last year's debit balance, and £9,000 for debenture interest, the debit balance is £19,170.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—Profit for the year ended September, 1916, £9,742. The working expenses fell by £2,445. The available balance will cover all interest charges and leave £389 to carry forward.

Stock Exchange Notice.—Application has been made to the Committee to allow the following to be quoted in the Official List:—

India-rubber, Gutta-percha & Telegraph Works Co., Ltd.—£400,000 5 per cent. debentures.

J. G. White & Co., Ltd.—The "Financial Times" states that no interim dividend will be paid on the preference shares on 1st proximo.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Final dividend, 3 per cent. (being at the rate of 6 per cent. per annum) on account of the dividend accrued on the 6 per cent. preference shares.

Manila Electric Railroad & Lighting Corporation.—Dividend of 1½ per cent. (1.50 dol. per share) for the quarter to December 31st on the common stock.

East London Railway Co.—8s. 9d. per cent., less tax, on "B" debenture stock for the year.

STOCKS AND SHARES.

TUESDAY EVENING.

CABINET-MAKING and other home politics have furnished the Stock Exchange with more topics for discussion than has business, the latter being extremely quiet. The changes in the Cabinet have done a good deal to help confidence, but their effect so far has been more sentimental than practical, except that they produced improvements in the Consol market and, therefore, had a strengthening influence upon gilt-edged and other investment markets.

The nearer the approach of the new year, the greater grows the disinclination on the part of the investor to spend money that will denude his bank balance at the time when he likes to see the latter on a comfortable basis. One of the minor features has been a revival in the prices of Victoria Falls shares; the ordinary and preference have both improved, although the best prices were scarcely maintained.

The electric lighting market is dull and lumpish. Westminster ordinary receded to 6, Metropolitans to 2¼, Counties and Cities to 10¼ and 11½ respectively, and South Londons to 2¾. There is some little disappointment at the official silence in regard to the hope that something might be done to turn up the lights of London, at all events during the Christmas week—which, if it had been permitted, might have proved the prelude to a relaxing of the lighting restrictions generally.

As we have pointed out before, there is in every market a certain supply of shares always coming in from deceased accounts, and also from people who, for one reason or another, are obliged to sell. Accordingly, when it happens that demand proves unusually coy or limited, the shares which the anxious sellers want to dispose of have an undue effect upon prices. This is what is happening at the present time in the electric lighting section; and the market looks as though it were going to wind up the year in about as dull a state as it has experienced during the whole of the twelve months.

Gossip runs in the City that one of the directions in which the vigour of the new Cabinet will manifest itself is an increase in the income-tax, 6s. 8d. in the £ being already mentioned as a possible next step. This rumour is accompanied by another to the effect that the excess profits tax is likely to be raised to 75 per cent.; and reports of this sort obviously do not lend strength or stability to markets at a time when fresh investment shows itself shy.

Practically every day sees further declines in the list of Home Railway stocks. The Board of Trade warnings as to the strong desirability of curtailing Christmas travel, with the rider that private journeys are likely to be made as difficult as possible, is the latest bear point put forward. The proposal to increase season-ticket and other rates would no doubt have had a strengthening effect in the railway market in the ordinary way; but when it comes on top of such announcements from the Board of Trade as those already quoted, it acts in the opposite direction.

In the Underground group, Districts went back to 15½ and Metropolitans to 23; but Underground Electric Railways issues keep firm, the price of the income bonds being well maintained at 91 bid. The falls in Steam stocks are spread over all the various classes of Home Railways, and those with electrified systems have weakened with the rest. The lists of preference and other pre-ordinary securities are lower, and the whole of the market is in a friendless condition.

British Columbia Electric Railway stocks moved down on renewed efforts to sell. Some associate the weakness with the dull state of the market for Canadian railways, but this seems scarcely sufficient to justify the drop. It may be that the previous rise was too rapid, or perhaps foreknowledge of the next report has something to do with the steady decline. At any rate, there is considerable interest, tinged with anxiety, as to what that document is likely to show.

The Brazilian exchange is in a more hopeful state, having kept about 1s. to a trifle over for nearly a week. The steadiness had a partial effect in checking the drop in Brazilian Traction shares, but the usual quarterly nervousness expressed with regard to the maintenance of the 4 per cent. dividend led to a further fall in the common. The preferred remain about 85½.

British Electric Traction ordinary is changing hands on the basis of 34, and business was marked the other day in the 6 per cent. preference stock at 76; while a buyer of London United Tramways paid 46 for the 4 per cent. debenture stock. Metropolitan Tramways 5 per cent. debenture stock has been negotiated on the basis of 80½ during the past week.

No recovery has occurred in the Mexican industrials, the shares and bonds of the Mexico Tramways and the Mexican Light & Power Companies being extremely weak. Pachuca Light & Power 5 per cent. bonds, which are guaranteed by the Mexican Light & Power Co., have fallen 3 points to 27½.

The Canadian-American power issues are mostly good. Pennsylvania Water & Power shares at 89½ and Shawinigans 140, but Canadian Generals gave way a little to 123¾. Victoria Falls preference rose to 22s. 3d., and the ordinary to 14s., before reacting to the extent of a few pence each.

The Telegraph market continues to find more sellers than buyers, and Easterns dropped a point to 139½. As a whole, however, the market is a little steadier than it was. United River Plate Telephones eased off to 6¾. Marconis have gone back ½ to 2¾, Americans and Canadians being sympathetically dull at 15s. 3d. and 9s. 6d. respectively. Globe ordinary and preference are a firmer market, and the industrial shares in the group are unchanged on the week. American Telephone 4 per cent. bonds fell 6 points to 105, and the 4½ per cents. are 7 lower at 111.

Edison & Swan fully-paid shares reacted to 1⅛, and Electric Constructions at 1 1/16 are the fraction down. The industrial market goes softly. British Aluminium remain active and firm at 30s. The iron and steel group is heavy, consequent upon the increase of wages granted to the miners in South Wales, and the uncertainty felt with regard to the effect of the Government's taking over the control of the field. A severe shake-out in the shipping market has not passed unnoticed by holders in other industrial companies the shares in which have recently been run up to high prices.

The rubber market is well maintained, in consequence of the strength of the raw material. The copper group experienced something of a flurry in New York by reason of the action of the British Government in restricting copper imports, but little effect was produced upon the prices of shares in British companies. Speculative enterprise here, as in other parts, is at a low ebb just at present.

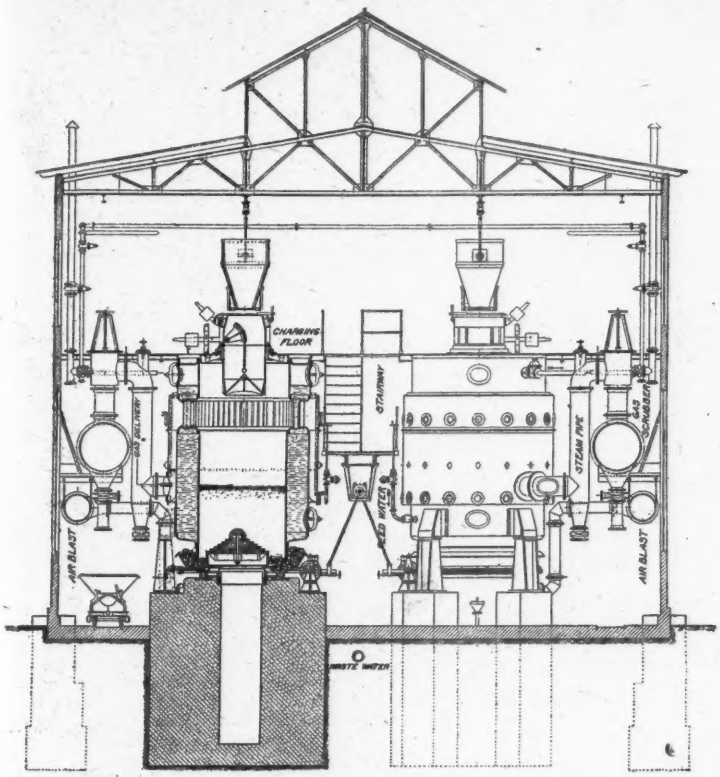
SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Dec. 12, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6⅜	—	£7 11 0
Charing Cross Ordinary	5	5	3⅝	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	5 7/8	—	6 11 0
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11½	— ⅛	6 19 2
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	— ¼	6 16 7
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	9	7	6⅜	—	6 4 5
London Electric	4	3	1½	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/8	—	6 15 4
Metropolitan	3½	3	2½	— ⅛	6 13 4
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	10	8	6½	—	6 8 0
South London	5	5	2¾	— ⅛	7 5 6
South Metropolitan Pref.	7	7	1 3/8	—	6 7 3
Westminster Ordinary	9	7	6	— ⅛	5 16 8
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	95½	—	6 5 8
do. Def.	30/-	33/6	23½	—	7 10 3
Chile Telephone	8	8	7⅛	—	5 12 3
Cuba Sub. Ord.	5	5	8¼	—	6 8 6
Eastern Extension	7	8	13⅜	—	*5 16 6
Eastern Tel. Ord.	7	8	189½	—1	*5 14 6
Globe Tel. and T. Ord.	6	7	12½	—	*5 12 0
do. Pref.	6	6	10⅝	—	5 18 5
Great Northern Tel.	22	22	37½	—	5 17 4
Indo-European	13	13	51	—	6 7 8
Marconi	10	10	2⅝	— ⅛	3 12 9
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2 3/8	—	4 6 6
United R. Plate Tel.	8	8	6¾	— ⅛	*5 18 5
West India and Pan.	1	6d.	1 1/8	—	2 4 0
Western Telegraph	7	8	14	—	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	1½	1	28	— ½	4 7 0
do. District	Nil	Nil	15½	— ½	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	91	—	*6 11 10
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅛	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	8¼	—	8 9 2
do. 2nd Pref.	5½	5½	2¾	—	—
do. 5 Deb.	5	5	67	—	7 9 3
Brazil Tractions	4	4	45⅞	— 1½	8 14 10
Bombay Electric Pref.	6	6	10½	—	5 17 3
British Columbia Elec. Ry. Pfce.	5	5	67	—2	7 9 3
do. do. Preferred	—	Nil	46	—	Nil
do. do. Deferred	—	Nil	43¼	—3½	Nil
do. do. Deb.	4½	4½	62	—	6 17 4
Mexico Trams 5 per cent. Bonds	—	Nil	33½	—	Nil
do. 6 per cent. Bonds	—	Nil	27⅞	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	17⅞	—	Nil
do. 1st Bonds	Nil	Nil	39½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	21¾	—	5 2 0
British Aluminium Ord.	5	7	30/-	—	5 6 8
British Insulated Ord.	15	17½	113	—	7 6 10
British Westinghouse Pref.	7½	7½	2 7/8	—	6 8 0
Callenders	15	20	13	—	7 13 10
do. 5 Pref.	5	5	4¼	—	5 17 8
Castner-Kellner	20	22	8½	—	5 6 8
Edison & Swan, £3 paid	Nil	—	7/8	—	Nil
do. do. fully paid	Nil	—	1⅛	— ⅛	Nil
do. do. 4 per cent. Deb.	5	5	69½	—	8 0 0
Electric Construction	6	7½	1 1/16	— 1/16	7 1 2
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	18⅝	—	7 5 6
Henley	20	25	16	—	7 16 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	13½	—	*7 12 4
Telegraph Con.	20	20	88	—	*6 5 0

* Dividends paid free of income-tax.

THE USE OF LOW-GRADE FUEL.

As the result of investigations by the U.S. Bureau of Mines into the use of low-grade fuels some interesting, though, of course, not entirely new, particulars of work carried out along these lines were recently published in one of the official publications of the department. The subject is of some interest in this country, as was indicated in Prof. Fearnsides' remarks quoted on page 621 of our last issue. Attention is drawn to the successful use of certain fuels in Europe and the complete indifference to the possibilities of similar fuels in the United States.



Revolving Eccentric-grate Producer Installation.

Information was sought in regard to (*a*) the utilisation of high-ash coals, (*b*) the use of wood refuse, (*c*) recovery of by-products, (*d*) recent developments in the preparation and use of peat, (*e*) results of low temperature distillation of fuels, (*f*) possibilities of the slagging type of gas producer, and (*g*) use of powdered coal. Excessive clinkering with high-ash fuel, leading to interruptions and failure to develop rated capacity, is the main objection to the use of such fuel.

To handle this and other classes of fuel the revolving eccentric grate producer has been developed in Europe. With it the ash is automatically removed, operation can be continuous, the output per unit area is increased, and a more uniform quality of gas is claimed.

The degree of eccentricity can be varied to suit the fuel, the tendency being to grind the coarse ash and prevent clogging; the speed is also variable to suit conditions of fuel and output, and usually runs from ⅛ to 1¼ revs. per hour, with 1- or 2-h.p. driving motors.

Experience has shown that an important factor in overcoming clinkering and fusing of the ash with the producer lining, is water jacketing the part of the producer shell surrounding the hot zone. In certain designs a variation is made in the height of the grate to correspond to the clinkering tendency of the fuels.

Either dry or wet bottoms are used, the former being sometimes regarded as desirable for extremely fine fuels burned with high air pressure, because of the depth of water necessary with the wet-bottom type.

The revolving grate producer is said to gasify two or three times as much fuel per sq. ft. of fuel bed as the fixed type; low percentage of carbon in the ash is also claimed, while the steam requirements are placed at about a fourth of those of the fixed grate jacketless type of producer. The total cost of a complete plant is said to be in favour of the revolving grate producer, which is claimed to handle 45 to 55 per cent. of ash with ease. An example is quoted of an English colliery and ironworks using an installation of eccentric grate producers, for which fuel is obtained by crushing and washing material from colliery refuse heaps, the fuel as used in the producers containing about 25 per cent. of ash

Reference is made to the use of refuse fuel in gas producers, such as wood refuse, husks, nut shells, tan bark, &c.

We illustrate an up-draught producer with mechanical tar extractor, and a down-draught producer; this type of plant has given good results, particularly with wood refuse.

Reference is also made to the use of by-product gas installations to utilise low-grade materials and colliery refuse, but in England it is considered that the tendency is always to use the material giving the largest by-product return, even though the plant was specifically intended to use only refuse material with a view to selling all high-grade fuel.

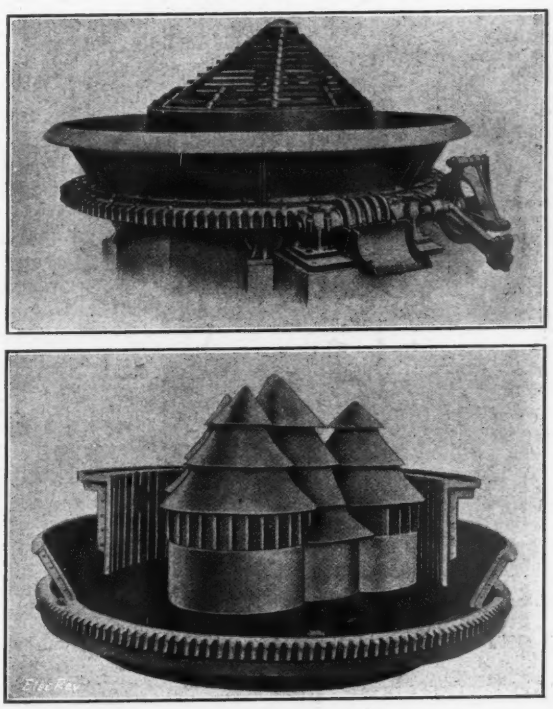
The subject of low-temperature distillation is discussed at some length, but it is remarked that little disinterested information was available.

The original intention of this process was to obtain a smokeless fuel for domestic use, and at the same time recover oil, motor spirit, and ammonia. Cannel coal, shale, high-ash coals, peat, and even briquetted sewage sludge were tested as fuels, but the results are not obtainable.

In a University lecture before a Manchester gas association, Mr. F. D. Marshall, referring to the subject of low-temperature carbonisation in vacuo, said that low-temperature distillation could not be completely successful if carried out under pressure, as with a temperature of only 900 deg. to 1,000 deg. F. the time of distillation would be too long, and the valuable oil constituent and the coke would be ruined. But low temperature, plus a complete, or nearly complete, vacuum in the retorts, enabled them to carbonise in three or four hours, and so save the light oils, and at the same time produce a hard, dense, easily ignitable coke or fuel containing 5 to 10 per cent. of volatile matter (probably methane) and over 80 per cent. of carbon free from all tarry and condensable matter.

The density of the coke was due to the compression of the coal between the annular spaces—a density which would effectually prevent the quick evolution of the gases were it not for the extreme vacuum employed.

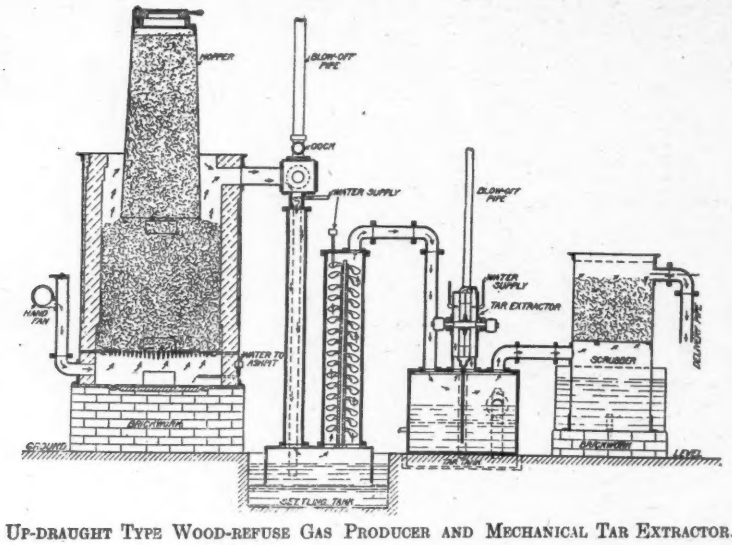
By the time the gases had passed the vacuum pump, everything condensable under atmospheric and impact conditions had been removed; but tailing on to the vacuum pump was a compressor, in which the entire gas was compressed under a pressure of 50 to 60 lb. to the sq. in. By a mechanical arrangement the pressure was suddenly released, the result being that the gas parted with a vapour which, on speedily condensing, proved to be a spirit of high value. The yield from this portion of the plant was approximately one gallon



Two Types of Revolving Eccentric-grate.

of spirit (specific gravity 0.818) per ton of bituminous slack. Passing from the compressing plant, the gas, at this stage of approximately 750 B.TH.U., passed through a stripping plant, which reduced it to about 300 B.TH.U. The choice of the crude oil for stripping purposes was important. The spirits must not be confused with benzols, as they were practically paraffins, or paraffinoids, and their homologues.

The yield of gas per ton of coal was approximately 5,000 cu. ft. from slack and 7,000 cu. ft. from cannel, and was



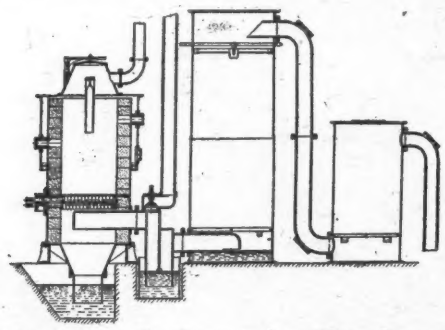
Up-draught Type Wood-refuse Gas Producer and Mechanical Tar Extractor.

partially consumed under the retorts and for running the works plant after it had been stripped of its valuable products.

Dr. Young, in a report, is said to have described the process as one of destructive distillation of coal at low temperature (900 deg. to 1,000 deg. F.) under a high vacuum (20 to 25 in. of mercury), resulting in the formation of products very different to those obtained by the usual gas-works practice of distillation at high temperatures. While the general nature of those products was the same whatever coal might be used, the amounts in which they were obtained varied with the class of coal, consisting generally of 70 per cent. of coke or residue and about 50 gallons of oil from a cannel coal, or 24 gallons of oil per ton from a bituminous coal. The process resulted also in the formation of ammonium in generally good amounts, but varying markedly with the coal employed.

The coke, or residue, was a dense but porous fuel; it was easily ignited, and could be burned in any ordinary open grate; it could also be used in the manufacture of suction gas, with the great advantage of yielding a gas entirely free from tarry matters.

In regard to their specific gravities, the "tarless fuel" oils lay between shale oil and gas-works tar, to the former of which they were much more closely related in their chemical nature, consisting of paraffinoid compounds and unsaturated derivatives. The benzenoid hydrocarbons, includ-



Down-draught Gas Producer for Wood Refuse.

ing the volatile solids, such as napthalene and anthracene, which formed such a large proportion of gas tar, were entirely absent. Hence the light oils on a fractionation yielded solvent naphtha and a motor spirit which resembled petrol rather than benzol. The total light oils, obtained partly by fractionation of the condensates and partly by stripping the gas, averaged 3.5 gallons per ton of coal.

Mr. Marshall suggested instead of charging generators with the crude coal direct from the collieries, first to treat it by a low-temperature plant, recovering the oils, gas, and what ammonia was produced by such a process, and then to feed the generators with the resultant clean and pure carbon coke.

The Bureau of Mines investigator finally refers to the use of the slagging gas producer and the use of powdered fuel, in regard to which several articles have already appeared in our pages.

In a paper read before the American Peat Society, Mr. B. F. Haanel discussed the subject of peat for power production. He pointed out that peat in the bog contains usually 87 per cent. water, 7 per cent. combustible matter, and a varying percentage of ash, so that more than 100 lb. of raw material must be handled in various ways before 10 lb. of combustible matter is available. The moisture can be separated by the application of artificial heat, hydraulic pressing, or sun heating. The first method of reducing moisture is shown to be impossible; all efforts to reduce the moisture below 75 per cent. by means of presses alone have not met with economic results, and a change in the chemical constitution of the peat is required before a further reduction of moisture can be obtained. The Ekenburg wet carbonising process was devised for this, but has not up to the present proved feasible. The only successful system has been sun and wind drying, and several million tons of peat fuel are manufactured annually in Europe by this method.

When by-product recovery in connection with the gasification of fuel is considered many important factors arise. Peat fuel cannot compete with reasonably priced coal for steam generation by means of boilers. The only large plant of the kind is at Wiesmoor, in Germany, of which the author gives some data. It is stated that with peat fuel costing 5s. per ton, the plant generates steam more cheaply than from coal costing 14s. 6d. per ton.

In actual service, about 6 to 6½ lb. of peat (30 per cent. moisture) per KW.-hour is required, which represents practically the same fuel cost as if coal were used. With peat fuel used in a well designed gas producer plant, it has been found that 1 B.H.P.-hour can be produced from 2 lb. of peat containing 25 per cent. moisture; this compared with 1½ lb. of coal. The value of peat as a fuel depends on the nearness to the plant of the raw fuel and the availability of ample storage.

ECONOMIC POWER GENERATION AND DISTRIBUTION.

In an address delivered under the auspices of the American Society of Mechanical Engineers, early in the present year, Mr. Samuel Insull dealt at length with the above subject, taking as an example the progress made in electrical genera-

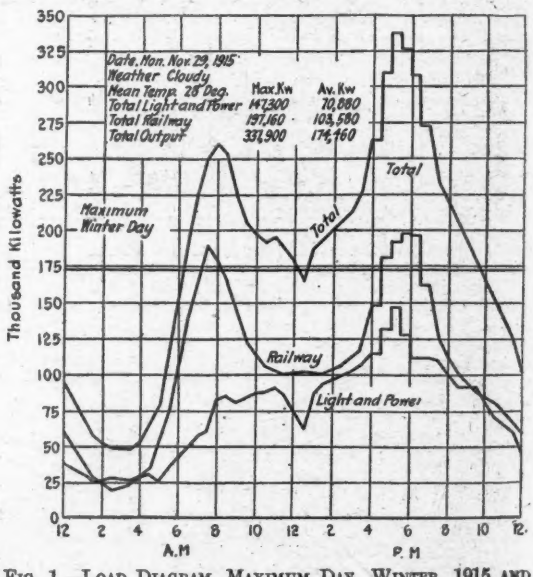


Fig. 1.—Load Diagram, Maximum Day, Winter, 1915 and 1916, Chicago.

tion and distribution in Chicago. As showing the diversity of demand, he pointed out that in November, 1915, on the day of coincident maximum data, the light and power busi-

ness took 147,300 KW.; the railways took 190,600 KW., giving a combined total of 337,900 KW. The non-coincident maxima for the winter came on December 22nd, in the light and power business which then took 155,670 KW. For railway business the non-coincident maximum was 203,560 KW. on January 6th, 1916, so that they took care of the non-coincident maxima of the two branches of business (359,230 KW.) with a total coincident maxima of 337,900 KW., showing a diversity of 21,330 KW. Chicago doing a wholesale and retail business combined showed a 43 per cent. load factor in 1915; the street and elevated railway demand was 35 per cent. greater in winter than summer.

Next to the inventions of the original D.C. distribution system and A.C. system, the development of the large turbine had had the greatest influence on the industry.

But it did look as though many managers were installing

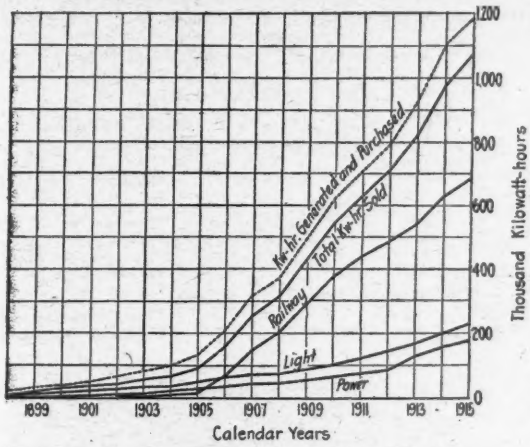


FIG. 2.—KW.-HOURS PRODUCED AND SOLD, CHICAGO.

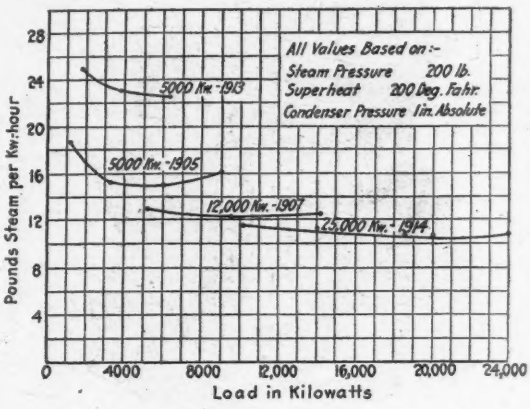


FIG. 3.—STEAM ECONOMY TESTS OF STEAM TURBINES.

turbines of a size out of all proportion to their requirements and having no relation to the load to be dealt with. He did not think it safe to order a unit for much more than 10 to 12, or, at the extreme, 15 per cent. of the total demand on any one system. This referred to existing systems, and new undertakings were in a different situation.

At the present time about 35,000 to 40,000 KW. was the largest size obtainable; 50,000 KW. had been mentioned, but before this size was adopted they would need higher boiler pressures and many experiments with apparatus.

The progress of the next few years would be better made if it was slower made.

The total business in Chicago in 1915 was almost $21,000,000; light accounted for $11,000,000, and power and transport

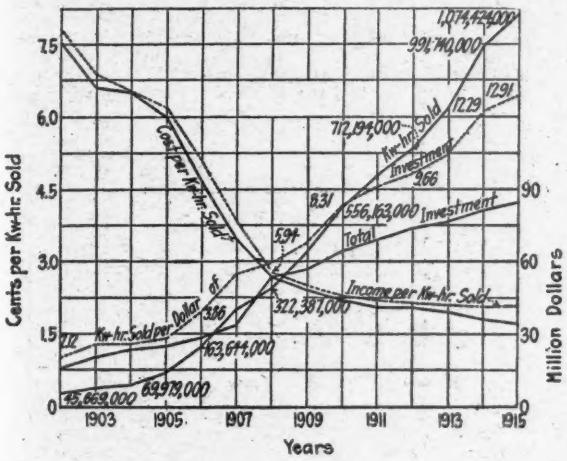


FIG. 4.—FINANCIAL CHART, COMMONWEALTH EDISON CO., CHICAGO.

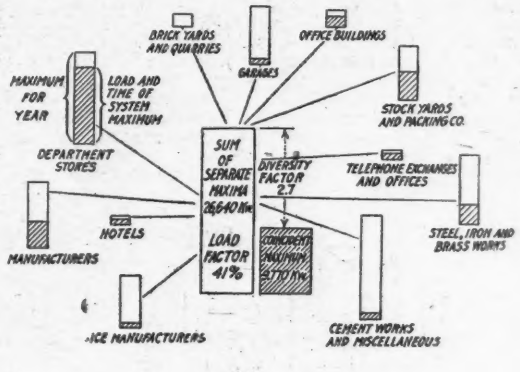


FIG. 5.—DIVERSITY OF LARGE OR WHOLESALE LIGHT AND POWER CONSUMERS.

halved the remainder. The wholesaling of energy for transportation showed a steady income; as the business developed the price dropped in 1906, and that price had continued up to the present; it was on a lower basis than it was possible for the local transportation companies of Chicago to produce energy themselves.

An interesting chart shows the steam economy tests of various sized turbines installed by the company during past years; the curve for the 25,000 KW. relates to a "reaction" type machine (which may be recognised by English readers).

As regards future possibilities, the light and power business of the Commonwealth Edison Co. was approximately 338,000 KW., that of isolated plants was 264,500 KW., and that of the steam railroads was 125,700 KW., making a total of 728,200 KW.

It was estimated that the company was doing about 46 per cent. of the total possible business; if it had the entire business, instead of a load factor of 40 or 41 per cent., it would probably have a 50 or 60 per cent. load factor. That meant that the cost of carrying the necessary investment for a city of two and a half million people, that was the interest and depreciation cost, if all the energy was produced by one organisation would be reduced approximately 33⅓ per cent.

That indicated that it was an economic waste for the individual to spend money in producing energy in a small way, and that the true function of the large electric light and power companies was to produce all the energy required in the community.

He was inclined to think that the day would come when one of the regulating bodies would step in, insist on all energy being produced from central generating plants, and tell people who were guilty of economic waste that they must stop it.

If equipment was employed unnecessarily, if fuel and labour were used wastefully, all these things must be harmful to the general wealth of the State.

If they took all the settled areas of the United States wherever there was a great density of population, and worked out the data on the same basis as it was worked out for the city of Chicago, and assumed that the electricity supply business was all put under a series of central organisations, they found that it took about 68 to 70 million H.P. of non-coincident demand; that the coincident demand would be about 47 million H.P., and that the diversity would be upwards of 20 million H.P. Capitalising the labour and fuel saved and the investment cost on 20 million H.P. would result in staggering savings.

Some people would tell them that such a system would produce a combination that might be dangerous to the State. It was not dangerous to the State to let its money go to waste, to waste its resources and its capital, but it was said to be dangerous to the State to allow an organisation to double its size, even though that organisation was regulated by a Commission of the State appointed or approved by the State Legislature.

He thought that that kind of danger was to the highest possible advantage to the State; that it was a real contribution to the better management of the country's affairs.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

"Overseas" Small Lighting Sets.

The Overseas Engineering Co., Ltd., of 75, Curtain Road, E.C., is introducing a small self-contained, automatic electric lighting plant for supplying thirty 20-c.p. lamps, shown in fig. 1. It consists of a 3-in. bore, 4½-in. stroke, four-cycle, water-cooled petrol engine, coupled direct to a 750-watt, 32-volt motor-generator on a 22 in. by 32 in. base, together with switch box and a 12-cell storage battery. The plant is arranged to operate either automatically or non-automatically; in the former case the withdrawal of energy from the battery, due to lamps being switched on, &c.,

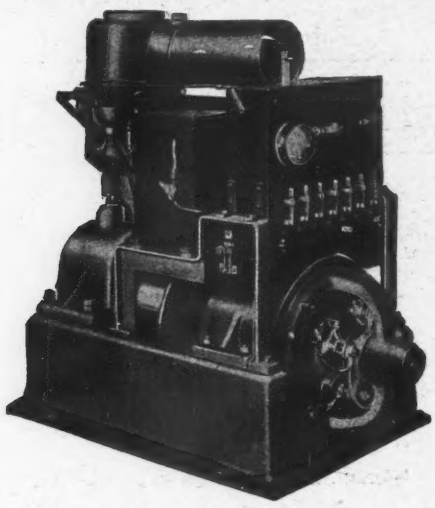


Fig. 1.—"Overseas" Automatic Electric Lighting Plant.

automatically starts up the engine (the generator functioning as a motor until the engine begins to fire) and the recharging of the battery commences.

With the switching-out of the lamps the plant comes to rest, ignition circuit open, oil feeding stopped, compression release latched, &c., and battery completely charged, provided the set has been working 15 minutes or so.

This particular plant is standardised and known as the "Home size, being most in demand; it is especially suitable for houses, farms, workshops, &c.

Another Mazda Revolving Shade.

About a year ago The British Thomson-Houston Co., Ltd., introduced an ingenious advertising novelty in the form of a revolving shade. This was intended for use with table, desk, and other fittings in which the lampholder was in an upright position. When the lamp was switched on, the shade rotated owing to an upward current of air, heated by the lamp, impinging upon a fan

Fig. 2.—Mazda Pendant Revolving Shade.

disk attached to the upper part of the coned shade and pivoted upon the tip of the lamp. The company has now produced an adaptation of the design that permits of its attachment to plain pendants.

From the accompanying illustration it will be seen how the revolving shade appears when in position. Any existing shade having been removed from a lampholder hanging from ordinary flexible cord, it is replaced by a specially designed wire frame, which is held in place by the shade-carrier ring. When the frame has been attached, it is turned upside down, and the flexible wire threaded through the hook at the apex of the coned frame and two loops that are formed at the top and bottom of one side. The frame will then hang vertically, with the holder in an upright position. The ends of the curved shade of stout coloured paper are then brought together, a cardboard disk with metal centre to fit over the lamp tip is inserted near the top of the shade, and the complete shade is placed on the lamp tip so that it is free to rotate within the wire frame. When the lamp is switched on, it illuminates the coloured shade, which immediately commences to revolve, the effect being both striking and attractive. If the adapted pendant be placed in a sunny position, its shade will rotate during the hours of sunlight without the lamp being lighted.

Readers in the Trade who have not received one of these revolving shades can obtain them upon application to the Publicity Department, The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C.

Mining Bells and Relays.

Mining bells and safety relays with parallel-wound coils, made by the Sterling Telephone and Electric Co., Ltd., of 210-212, Tottenham Court Road, W., were tested by Dr. Wheeler and Prof. Thornton in their recent investigation of the subject of bare-wire signalling in mines, and found to be safe with all pressures up to the maximum permitted by the regulations. The company consider this method of preventing dangerous sparking to be the most practical and efficient of those suggested, and have put on the market a series of bells and relays of this type, which comply with the new requirements of the Home Office. We illustrate in fig. 3 the relay, which is enclosed in a separate compartment in a cast-iron case, with a machined-surface flame-proof cover; the terminals

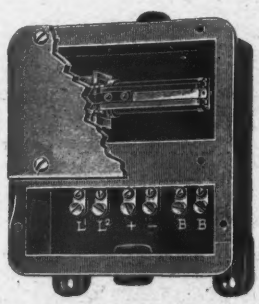


Fig. 3.—Sterling Safety Relay.

are fixed in a lower compartment with a separate cover, which can be removed for wiring without exposing the relay to damp and dirt, and the wires connecting the relay to the terminals pass through a trough in which they are sealed with bitumen before leaving the makers' works. The relays are made with resistances of 20, 100, and 500 ohms, and, as an example, the 100-ohm relay with 15 volts works well through an external resistance of 280 ohms. The safety bell is also enclosed in a cast-iron case, gas and watertight, the motion of the armature being transmitted to the hammer through a metal diaphragm.

THE DETERMINATION OF TRANSFORMER LOSSES.*

By PERRY A. BORDEN.

When determining the efficiency of a transformer by the method of direct loading, it is usual to read the input and output on separate wattmeters, the ratio of these slightly differing quantities being the efficiency of the apparatus. The actual losses are thus represented by a very small portion of the scale, and the difference of two quantities both subject to the errors of the instruments used.

In what follows, a method is described wherein the total losses taken collectively are directly read on an independent wattmeter. The apparatus for making the measurements includes:—

1. A single-phase wattmeter of suitable scale to measure the losses (say 100 volts, 0.5 amp.).
2. A variable load, preferably of the potentiometer type, to give full scale on this meter.
3. A polyphase wattmeter or watt-hour meter free from interference troubles, carefully adjusted to "buck on zero," *i.e.*, to have zero torque when the two elements are measuring quantities of equal and opposite magnitude. The circuits of the polyphase meter will be (usually) 100 volts, 5 amp.

* From the *Electrical World*.

The accompanying diagram shows the arrangement for measuring total losses in a 10-kw. 2,200/110-volt transformer. The instrument transformers are so chosen that the constants of the two elements of the polyphase meter are equal. In this case the primary voltage is measured with a 2,000/100 potential transformer, while the secondary current passes through a 100/5 series transformer, the constant of each phase of the meter being 20. The polyphase instrument is connected in such a way that while the input gives a positive deflection, the output tends to oppose it.

The single-phase meter is then placed in circuit as shown, receiving its potential from the same source as the output element of the polyphase meter, and its current from any source approximately in phase with the potential. If the source of supply for the auxiliary current be not electrically connected to the main supply, the auxiliary meter A may, if desired, be connected to the input element of the wattmeter B. The adjustable current of meter A passes with the load cur-

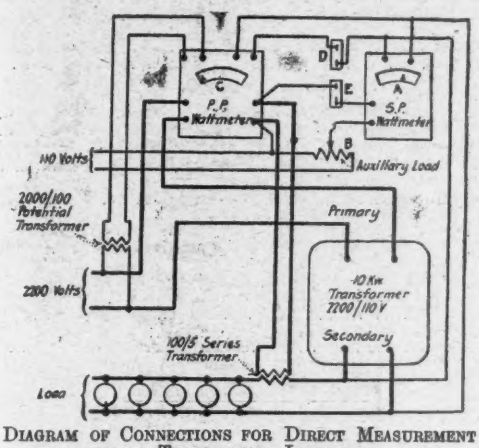


Diagram of Connections for Direct Measurement of Transformer Losses.

rent through the polyphase instrument in such a direction as to give a small additional negative torque. It is, of course, understood that sufficient grounding or interconnection will be made to prevent dangerous voltage between parts of the polyphase wattmeter.

The method of operation is as follows: With switches D and E open, the transformer is loaded until the desired input is read on the scale of meter A. Switch D is then closed, and the indication falls to the small value representing the difference between input and output (*i.e.*, losses). Switch E is then closed and the auxiliary current is carefully adjusted until meter B indicates exactly zero. The reading of the auxiliary meter multiplied by the metering constant represents then the total losses in the transformer under test, and the efficiency may be accurately determined by the usual formula.

This method is particularly suitable to the testing of large numbers of similar transformers, and will be found suited not only to transformers, but to any class of electric apparatus in which both the incoming and outgoing energy are carried on two-wire circuits.

TRADE STATISTICS OF JAPAN, 1915.

The following statement, showing the imports into and the exports from Japan of electrical and similar goods during the year 1915, is taken from the recently-issued official trade statistics; the figures for 1914 are given for purposes of comparison, and notes of any increases or decreases are added:—

	1914. Yen.	1915. Yen.	Inc. or dec. Yen.
Galvanised iron wire.—			
From Great Britain ...	262,000	146,000	– 116,000
,, Germany	1,486,000	39,000	– 1,447,000
,, Belgium	66,000	—	– 66,000
,, Austria	8,000	—	– 8,000
,, United States ...	304,000	2,969,000	+ 2,665,000
,, Other countries ...	2,000	21,000	+ 19,000
Total	2,128,000	3,175,000	+ 1,047,000
Posts and materials for electric lines.—			
From Great Britain ...	2,000	—	– 2,000
,, Germany	24,000	—	– 24,000
,, United States ...	580,000	2,000	– 578,000
,, Other countries ...	6,000	—	– 6,000
Total	612,000	2,000	– 610,000
Copper (pipes and tubes).—			
From Great Britain ...	105,000	37,000	– 68,000
,, Germany	31,000	—	– 31,000
,, Other countries ...	16,000	1,000*	– 15,000
Total	152,000	38,000	– 114,000
Insulated electric wire.—			
From Great Britain ...	160,000	6,000	– 154,000
,, Germany	235,000	94,000	– 141,000
,, United States ...	48,000	13,000	– 35,000
,, Other countries ...	1,000	—	– 1,000
Total	444,000	113,000	– 331,000
Steam turbines.—			
From Great Britain ...	22,000	—	– 22,000
,, Germany	139,000	—	– 139,000
,, United States ...	2,000	24,000	+ 22,000
Total	163,000	24,000	– 139,000
Cranes.—			
From Great Britain ...	150,000	20,000	– 130,000
,, Germany	124,000	—	– 124,000
,, United States ...	35,000	21,000	– 14,000
,, Sweden	24,000	—	– 24,000
Total	333,000	41,000	– 292,000
Pumps.—			
From Great Britain ...	209,000	182,000	– 27,000
,, Germany	240,000	9,000	– 231,000
,, United States ...	182,000	57,000	– 125,000
,, Other countries ...	34,000	19,000	– 15,000
Total	665,000	267,000	– 398,000
Gas engines, petroleum engines, and hot air engines.—			
From Great Britain ...	114,000	42,000	– 72,000
,, Germany	118,000	—	– 118,000
,, Sweden	31,000	85,000	+ 54,000
,, United States ...	88,000	35,000	– 53,000
,, France	2,000	—	– 2,000
,, Italy	2,000	—	– 2,000
,, Other countries ...	11,000	1,000	– 10,000
Total	366,000	163,000	– 203,000
Steam engines.—			
From Great Britain ...	244,000	51,000	– 193,000
,, Germany	181,000	—	– 181,000
,, United States ...	17,000	3,000	– 14,000
,, Belgium	10,000	—	– 10,000
,, Other countries ...	1,000	—	– 1,000
Total	453,000	54,000	– 399,000
Steam boilers.—			
From Great Britain ...	654,000	499,000	– 155,000
,, Germany	192,000	17,000	– 175,000
,, United States ...	13,000	52,000	+ 39,000
,, Belgium	2,000	2,000	—
Total	861,000	570,000	– 291,000
Dynamos, electric motors, &c.—			
From Great Britain ...	667,000	316,000	– 351,000
,, Germany	808,000	32,000	– 776,000
,, Switzerland	56,000	3,000	– 53,000
,, United States ...	1,211,000	390,000	– 821,000
,, Sweden	91,000	7,000	– 84,000
,, Other countries ...	10,000	1,000	– 9,000
Total	2,843,000	749,000	– 2,094,000
Water turbines and Pelton wheels.—			
From Great Britain ...	9,000	24,000	+ 15,000
,, Germany	206,000	18,000	– 188,000
,, France	—	15,000	+ 15,000
,, Switzerland	14,000	10,000	– 4,000
,, Sweden	81,000	30,000	– 51,000
,, Belgium	7,000	—	– 7,000
,, United States ...	—	21,000	+ 21,000
,, Italy	5,000	—	– 5,000
Total	322,000	118,000	– 204,000
Incandescent electric lamps.—			
From Great Britain ...	4,000	2,000	– 2,000
,, Germany	379,000	23,000	– 356,000
,, United States ...	8,000	6,000	– 2,000
,, Other countries ...	—	11,000	+ 11,000
Total	391,000	42,000	– 349,000

* United States.

	1914. Yen.	1915. Yen.	Inc. or dec. Yen.
Wattmeters.—			
From Great Britain ...	29,000	8,000	– 21,000
,, Germany	117,000	5,000	– 112,000
,, United States ...	36,000	62,000	+ 26,000
,, Other countries ...	11,000	43,000*	+ 32,000
Total	193,000	118,000	– 75,000
Ampere meters and voltmeters.—			
From Great Britain ...	7,000	2,000	– 5,000
,, Germany	13,000	—	– 13,000
,, United States ...	57,000	43,000	– 14,000
Total	77,000	45,000	– 32,000
Accumulators.—			
From Great Britain ...	93,000	39,000	– 54,000
,, Germany	18,000	—	– 18,000
,, United States ...	4,000	1,000	– 3,000
Total	115,000	40,000	– 75,000
India-rubber and gutta-percha, crude.—			
From British India ...	447,000	941,000	+ 494,000
,, Straits Settlements ..	1,357,000	1,727,000	+ 370,000
,, Dutch India ...	3,000	226,000	+ 223,000
,, Great Britain ...	319,000	394,000	+ 75,000
,, Germany	2,000	1,000	– 1,000
,, United States ...	16,000	118,000	+ 102,000
,, Other countries ...	3,000	25,000	+ 22,000
Total	2,147,000	3,432,000	+ 1,285,000

* Switzerland, Yen 42,000.

EXPORTS.

Electric machines and parts thereof.—			
To China	268,000	255,000	– 13,000
,, Kwantung Province ...	130,000	150,000	+ 20,000
,, Philippine Islands ...	2,000	4,000	+ 2,000
,, Siam	1,000	5,000	+ 4,000
,, Australia	15,000	65,000	+ 50,000
,, Hong-Kong	13,000	31,000	+ 18,000
,, British India	9,000	25,000	+ 16,000
,, Straits Settlements ...	4,000	6,000	+ 2,000
,, Germany	6,000	—	– 6,000
,, Other countries ...	4,000	41,000	+ 37,000
Total	452,000	582,000	+ 130,000
Insulated electric wire.—			
To China	132,000	399,000	+ 267,000
,, Kwantung Province ...	191,000	193,000	+ 2,000
,, Hong-Kong	9,000	61,000	+ 52,000
,, British India	—	9,000	+ 9,000
,, Dutch India	—	10,000	+ 10,000
,, Asiatic Russia ...	—	43,000	+ 43,000
,, Great Britain	—	160,000	+ 160,000
,, France	—	13,000	+ 13,000
,, Other countries ...	62,000	12,000	– 50,000
Total	394,000	900,000	+ 506,000

Yen = 2s. 0½d.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

16,957. "Telephone systems and apparatus." J. W. Dungey & C. B. Kersting. November 27th.

16,969. "Electrically-operated bells." F. G. Bell and The Sterling Telephone & Electric Co. November 27th.

16,990. "Electric tractors." E. C. R. Marks (Mercury Manufacturing Co.). November 27th.

16,992. "Electrical controller." E. C. R. Marks (Mercury Manufacturing Co.). November 27th.

17,001. "Evacuated electric discharge devices." British Thomson-Houston Co. & W. T. Munro. November 27th.

17,003. "High-frequency signalling." Western Electric Co. November 27th. (U.S.A., November 29th, 1915.)

17,011. "Automatic control apparatus for electric motors." H. V. James. November 27th.

17,048. "Electric heating and gas heating apparatus." J. H. Farthing, M. J. Railing & F. Winstanley. November 28th.

17,060. "Latching devices for alternating-current electromagnets." Akt. Ges. Brown, Boveri et Cie. November 28th. (Switzerland, January 10th.)

17,061. "Pivotal connection between alternating-current magnet and its armature." Akt. Ges. Brown, Boveri et Cie. November 28th. (Switzerland, January 10th.)

17,068. "Electric resistances." H. Snowdon. November 28th.

17,074. "Electric battery lamp." J. E. Hamilton. November 28th.

17,087. "Electric switches." V. Hope. November 29th.

17,095. "Coat for protection of X-ray workers." F. E. Teale-Doran. November 29th.

17,111. "Solenoid motor." J. Lane & G. Henwood. November 29th.

17,161. "Electric incandescent lamps." D. Lely, L. Hamburger & Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 29th.

17,170. "High-frequency signalling." Western Electric Co. November 30th. (U.S.A., December 1st, 1915.)

17,189. "Protection of electric supply or distribution systems in which split or parallel conductors are employed." J. O. Callender, Callender's Cable & Construction Co. and Electrical Improvements, Ltd. November 30th.

17,206. "Circuit interrupting systems." British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co.). November 30th.

17,209. "Electric switches." H. H. Berry & W. J. Markham. November 30th.

17,212. "System for controlling electric apparatus by wireless transmission." E. H. Widegren & K. Widegren. November 30th. (Sweden, December 20th, 1915.)

17,231. "Trolley pole heads for electric cars, &c." H. E. Warsop. December 1st.

17,242. "Holders for arc lamp carbons, &c." D. C. Williamson. December 1st.

17,244. "Non-flashing electric trolley arm." D. Branson. December 1st.

17,260. "Portable telephone and signalling apparatus." H. C. Crews. December 1st.

17,261. "Method of controlling electrically governors, valves, gates, planes, steering gears, &c." T. B. Campbell, A. J. Campbell & A. Martin. December 1st.

17,271. "Electric switches." L. J. Norton. December 1st.

17,273. "Cells for secondary batteries." G. Pearson. December 1st.

17,275. "Flashlamps." H. J. Cloake (C. S. Cloake). December 1st.

17,277. "Electric switches." H. C. Widlake. December 1st.

17,281. "Make-and-break switch for electric circuits." Johnson & Phillips & E. A. Leopard. December 1st.

17,286. "Appliance for attaching shades to holders of electric light fittings." W. Casson & J. Doble. December 1st.

17,292. "Electric motors." T. L. R. Cooper. December 2nd.

17,321. "Electrical contacts." British Westinghouse Electric & Manufacturing Co. December 2nd. (U.S.A., January 21st.)

17,334. "Time-limit relays." Akt. Ges. Brown, Boveri et Cie. December 2nd. (Germany, January 3rd.)

17,340. "Polarised relays." M. B. Rodriguez. December 2nd.

17,347. "Treating marble so as to impact electric insulating and weather-resisting properties to it." W. E. Windsor-Richards. December 2nd.

PUBLISHED SPECIFICATIONS.

1915.

8,480. Telephone Transmitters and Transmission. W. A. Yewen. June 8th. (November 9th, 1915.)

11,332. Incandescent Electric Lamps or/and in the method of manufacturing same, especially applicable to the manufacture of so-called Half-watt Lamps or Gas-filled Glow Lamps. C. O. Bastian. August 5th.

11,560. Apparatus for Displaying Advertisements, Signs, Notices, Outline Moving Pictures, or the like, or for Communicating Messages or Signalling both during Light and Darkness. J. P. Naylor & Naylorgraph, Ltd. August 10th.

15,842. Electrically-driven Adding and Listing Machines, Copying Machines, Typewriting Machines, Addressing Machines, or other Machines having Keyboards. J. Dracquer. November 10th.

15,878. Electric Switches. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 10th.

15,930. Electric Cells. C. Frey. November 11th.

15,985. Electric Lampholders for Vehicle Head Lamps. F. E. Wilson, W. A. Shepherd and Powell & Hanmer, Ltd. November 12th.

15,986. Electrical Connections for use in the Electric Lighting of Automobiles. F. E. Wilson, W. A. Shepherd and Powell & Hanmer, Ltd. November 12th.

16,112. Ohmmeters and like Electrical Measuring Instruments. H. E. Trent. November 13th.

17,302. Electric Lampholders. E. A. Welch. December 9th. (Cognate application, 6,867/16.)

17,475. Railway Signalling. W. R. Sykes Interlocking Signal Co., R. R. Harper & F. J. Sykes. December 14th.

18,166. Electrical Relays. S. G. Brown. December 30th.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

139. Microphones for use as Transmitters or Relays for Telephonic and similar purposes. H. Smith. January 4th, 1916. [102,067.]

425. Electrical Heating Apparatus. A. H. Taylor (H. Burgess). January 11th, 1916. [102,070.]

1,596. Electric Heat Radiators. A. F. Berry. February 2nd, 1916. [102,077.]

2,615. Electric Heating Apparatus. M. J. Railing & J. H. Farthing. February 22nd, 1916. [102,084.]

2,915. Railway Signalling. W. R. Sykes Interlocking Co. & R. W. Tarrant. February 26th, 1916. [102,087.]

3,099. Electrolytic Production of Sodium Perborate. Deutsche Gold and Silber-Scheidenstalt vorm. Roessler. March 1st, 1916. (Addition to 3,084/16.) [102,089.]

5,606. Electrical Means for Indicating or Transmitting Movements. H. R. Wright. April 17th, 1916. [102,104.]

6,031. Electric Devices for Automatically Turning Lights on or off. E. Steiger. April 28th, 1915. [100,365.]

7,009. Combined Electric Lampholder and Lamplock. A. H. Short. May 17th, 1916. [102,111.]

9,111. Methods and Apparatus for Heating Liquids. British Westinghouse Electric & Manufacturing Co. June 30th, 1915. [100,796.]

10,234. Telephone Directory. W. H. Aston. July 20th, 1916. [102,127.]

10,297. Devices for Attachment to Sparking Plugs for Automatically Cleaning and Cooling their Sparking Points. A. E. Lamkin. July 21st, 1916. (Addition to 8,470/16.) [102,128.]

12,160. Vapour Electric Converters. British Westinghouse Electric and Manufacturing Co. August 28th, 1915. [101,346.]

15,419. Ferrule or Sleeve for Braided Wire Coverings Employed on Cables. F. E. Wilson, W. A. Shepherd and Powell & Hanmer, Ltd. November 12th, 1915. (Divided application on 15,986/15.) [102,137.]